Vol. XXVIII. Part 8.

NATIONAL MUSEUM OF VICTORIA

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The Journal of the Department of Agriculture of Victoria, Australia.

August, 1930.

PRINCIPAL CONTENTS

Some Census Studies on the Wheat Crop of Victoria

Poultry Diseases

Diseases of Horses

Pasture Top-Dressing

The Pig Industry

Prune Drying

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THE JOURNAL

OF

THE DEPARTMENT OF AGRICULTURE

VICTORIA, AUSTRALIA.

CONTENTS.—AUGUST 1930.

	PAGE
Some Census Studies on the Wheat Crop in Victoria *H. C. Forster, M.Ag.Sc., and A. J. Vasey, B.Ag.Sc.*	449
Poultry Diseases—III., Fowl-Pox ... ... *Harold E. Albiston, D.V.Sc.*	459
Incubation .. .. *W. Pederick*	463
The Export of Eggs ... ... *W. C. Rugg*	468
Strangles in Horses ... ... *W. N. Lerew, G.M.V.C.*	471
Laminitis or "Founder" in Horses ... ... *S. A. Mountjoy, L.V.Sc.*	474
Pasture Top-Dressing Tests	476
The Pig Industry (continued) ... ... *A. J. Gill*	481
Australian Rain Forest Trees	485
Codling Moth Control (Report on 1929-30 Experiments at Harcourt) *R. T. M. Pescott, M.Ag.Sc.*	486
Rose Diseases and their Control ... ... *B. J. Grieve, M.Sc.*	490
Prune Drying ... . *F. de Castella*	497
Supplementary List of Fertilizers Registered for the Year 1930	508
Butter Making	511
Prosecutions under the *Fertilizers Act* 1928	512

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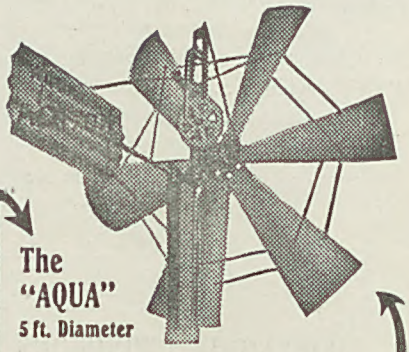

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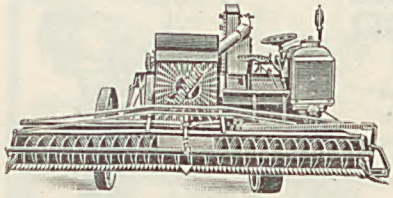

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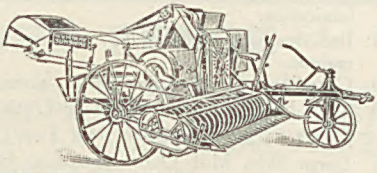

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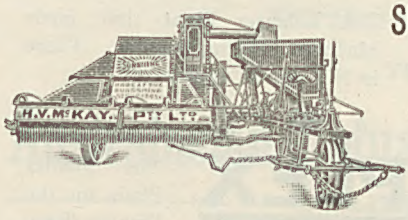

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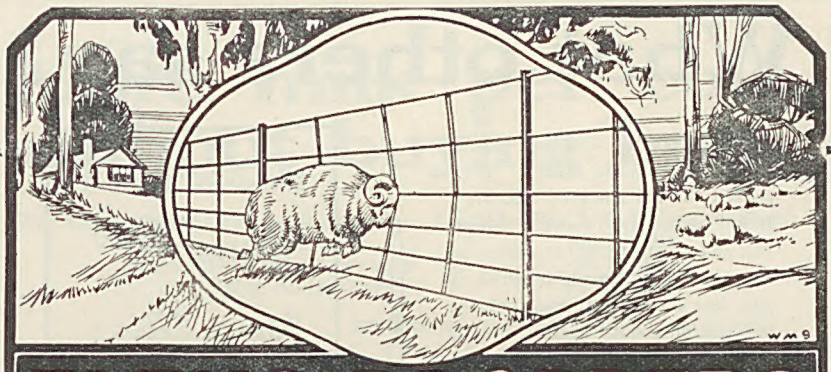

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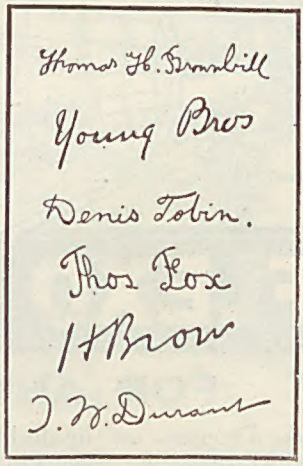

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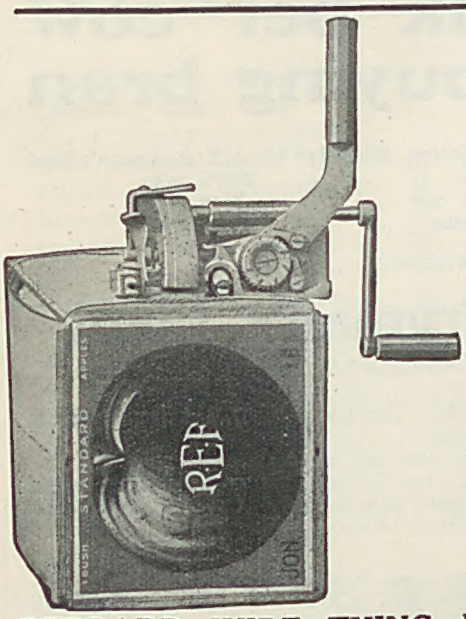

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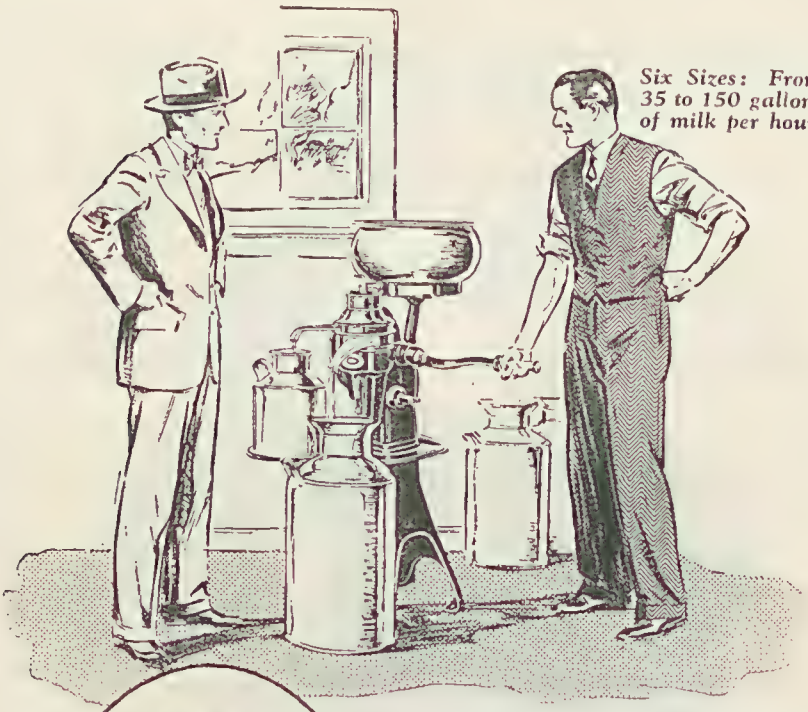

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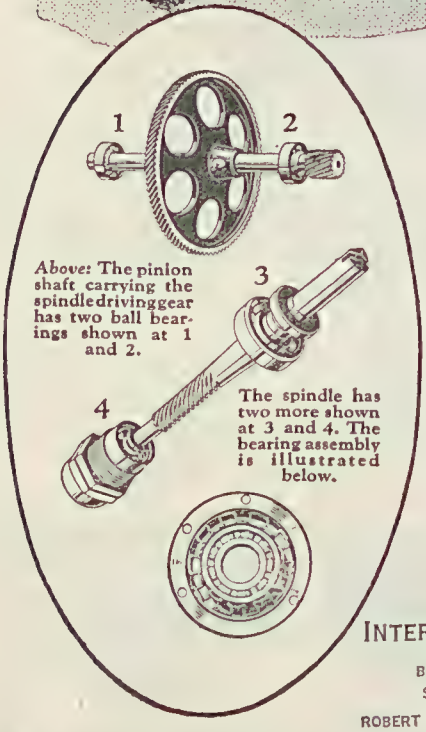

Above: The pinion shaft carrying the spindle driving gear has two ball bearings shown at 1 and 2.

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THE JOURNAL

OF THE

Department of Agriculture

OF

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Vol. XXVIII. August, 1930. Part 8

SOME CENSUS STUDIES ON THE WHEAT CROP IN VICTORIA.

(Paper read before the Agricultural Section of the Australian Association for the Advancement of Science, Brisbane Conference, May, 1930.)

By H. C. Forster, M.Ag.Sc., and A. J. Vasey, B.Ag.Sc., Department of Agriculture, Victoria.

Introduction.

In all the States of Australia marked success has attended the efforts of the wheat-breeders in the production, by cross-breeding and selection, of new prolific varieties. Thus we have Nabawa from Western Australia, Ford from South Australia, Free Gallipoli from Victoria, and Waratah from New South Wales, to mention only the more prominent productions of recent years. These elect few are the resultant of from some ten to fifteen years' work in all States, during which time many thousands of cross-breds and selections have been handled from stud rows through the seed multiplication plots to final yield-trial stage. These wheats have won through, and have been distributed after accurate yield trials which have proved them to have a superior grain yield to the standard varieties already in cultivation. Their success must be attributed to special or improved yield qualities.

While definite talent is required for the planning of a successful crossing programme, the art of the plant-breeder finds its greatest expression in the work of selection among the progeny of the crosses in the generations F2 to F4. He must be able to recognize the characters generally associated with high yield while the varieties are but in their second or third generation. Yield per unit area, as a help to selection, is of little value in the early stages when the pure lines are still being grown in rows, and until there is enough seed to sow small plots under field conditions, the new cross-breds are absolutely at the mercy of the plant-breeder.

It is reasonable to suppose that there are definite expressions of yielding capacity exhibited in the morphologic characters of the wheat plant, and it is more than possible that a measure of these characters

could be obtained from a field examination of successful varieties. Such information would be a great help, not only in planning the crossing programme for the combination of such characters, but also as a definite guide in the years of selection which follow the initial crossing.

The following notes describe the attempt made in Victoria during the last three years to obtain this information from a census study of the wheat crops, in the field, in various portions of the State.

Method.

The method of inquiry adopted was that developed by F. L. Engledow, at Cambridge, for the study of the growing crop, and described by him in the *Journal of Agricultural Science* (1926) 16. (1) under the title of "A Census of An Acre of Corn." This method has been used with success in the fundamental "Investigations on Yield in Cereals" commenced by Engledow and S. M. Wadham, at Cambridge in 1923, and continued by the former in conjunction with various other workers in more recent years. (2. 3. 4. 5. 6. 7.)

Yield per unit area is studied as the product of four factors "p," "e," "n," "g" where

p = plants per unit area,
e = average number of ears per plant,
n = average number of grains per ear,
g = average weight of grain.
y (yield) = p.e.n.g.

The basis of this method of study consists of the drawing of a requisite number of samples from the growing crop at various times during the growing period.

The unit sample is 1-foot length of drill row, and for each separate observation 100 are taken from one-half an acre of crop. The actual technique of the Victorian investigation is as follows:—Soon after germination 200 samples of 1-foot length of drill row are marked out in a systematic scatter on a typical half-acre of crop; and the young seedlings in each of these 200 samples counted "in situ" and recorded. In the spring, when the crops are at the height of their vegetative growth, another count is made, when 100 of the samples previously marked are pulled up, placed in numbered bags and removed to the laboratory for the counting of number of plants per foot, and number of stools or tillers per plant. Then at harvest, the remaining 100 samples are similarly treated, and on the material so obtained counts are made for number of plants per foot, number of ears per plant, number of grains per ear, and size of grain.

Thus the following average measurements are obtained:—

1. (*a*) Number of plants per foot at germination.
2. (*a*) Number of plants per foot at stooling.
   (*b*) Number of stools per plant.
3. (*a*) Number of plants per foot at harvest.
   (*b*) Number of ears per plant.
   (*c*) Number of grains per ear.
   (*d*) Weight of grain.

This method has been employed over the past three years in an inquiry into varietal differences in the four yield factors at four stations in different parts of the wheat belt, viz., at Longerenong in the Wimmera, Rutherglen in the North-East, Werribee in the Central District, and Carwarp in the Mallee.

During the last year it has been extended to supplement all tests with wheat whether cultural, manurial, or rate of seeding. Wherever a difference in yield with different treatments is obtained, it must be reflected in one or more of the yield factors quoted above, and the census inquiry goes hand in hand with the particular investigation to determine which of the four yield factors is affected and how.

It is not intended to give here detailed results of the studies, but rather to convey a general idea of the method and of the type and magnitude of the measurements obtained.

General Discussion.

1. Population "p."

In an acre of crop there are, at 7-inch spacing between rows, some 74,700 feet of drilling, and in good graded seed wheat there are about 10,000 grains per pound weight or approximately 600,000 per bushel (60 lb.). With such a seed sample, the following numbers of grains will be sown per foot of drill row over the common range of rates of seeding:—

45 lb. per acre. 6 grains per foot.	75 lb. per acre. 10 grains per foot.
60 lb. per acre. 8 grains per foot.	90 lb. per acre. 12 grains per foot.

Seed samples, however, vary considerably. In connexion with every census inquiry therefore a grain count is made on the seed sample sown in order to determine the actual figure for average number of grains sown per foot of drill row. Using this figure after the germination count it is possible to calculate the germination percentage for the crop under observation.

The germination count is usually taken when the young seedlings are in the three-leaf stage, and before any stooling has taken place. As might be expected with variations in soil and seeding conditions the germination percentage obtained in the field varies considerably. However, for fair average conditions on fallow in the Victorian wheat belt, the general figure may be stated at from 75-85 per cent.

Again, speaking of average conditions in Northern Victoria, there is usually little or no loss of plants between the germination and the stooling counts, that is from July to late September. Between stooling and harvest, however, the effects of foot-rot and take-all are noticed, and generally speaking only some 80-85 per cent. of the plants observed at germination survive to produce grain at harvest. All of this loss is not attributable to disease. There are many cases of death from apparently natural causes.

The general statement may be made, with all the qualifications of varying conditions altering cases, that for every three grains sown only two form plants which produce grain at harvest, a survival of some 66 per cent.

Stooling and Heading.

2 "e."

At germination the seedling wheat plant consists of a single shoot, but quickly develops into the three-leaf stage. Stooling does not commence until the plant is from two to four weeks old, when two stools are produced at the base of the main axis making three stems in all per plant. This form may be regarded as the primary wheat plant as provided that conditions are in any way moderate, stooling takes place to this extent almost irrespective of district, variety, soil or season, rate of seeding or manuring. These three main stools constitute the basal framework of the wheat plant on which all the superstructure of yield is built. The next few weeks are spent in the strengthening of this framework after which, if favorable conditions continue, secondary stools are produced at the base of the three main ones. This gives six in all per plant, and further stooling can go on "ad lib." Rarely under Victorian conditions does the average stooling per plant exceed six or seven. It is the production of these secondary stools which is influenced by variety and environment.

The environmental factor in this connexion may well be illustrated by reference to the results of a stooling count made on a Rate of Seeding test at Werribee in 1929—

Rate of Seeding in lb. per acre.	Number of plants per foot of drill row.	Average stooling per plant.	Average stooling per foot of drill row.
45	4·68	7·44	35·9
60	6·38	6·22	39·2
75	7·93	5·70	44·8
90	9·45	4·96	45·7
120	11·85	3·96	47·0

It will be noted that the plants under all conditions of spacing had the basal framework of three main stems, and from the figures can be seen the effects of the crowding of the plants in the higher rates of seeding on the development of secondary stools.

Typical differences in variety stooling are as follow:—

	Stools Per Plant.
Early Varieties (e.g., Rajah)	.. 2.5–3.5.
Mid-season Varieties (Free Gallipoli)	.. 3.5–4.7.
Late Varieties (Major, Wannon)	.. 4.5–6.0.

Thus at the stooling counts in the various observations the average plant has been found to consist of the three main stems plus a varying number of secondary stools. The stage of development to which these latter are carried before being sloughed varies greatly between varieties,

and is, in our opinion, an important factor in drought resistance. By October, however, they are generally only a prominent feature of late varieties.

With the advance in the season, head production takes place, and the observations have shown that, in the typical plant of the various crops studied, only the primary stools have produced heads. Besides varietal differences in ear production there is a very definite influence of seasonal and spacing conditions. In no district over the past three years did these conditions allow of the average production of three heads per plant, i.e., a head on each of the three main stems.

Varietal differences in heading under average conditions on fallow in the Victorian wheat belt may be quoted as follow:—

	Heads Per Plant.
Early Varieties (Rajah)	1.2–1.4.
Mid-season Varieties (Free Gallipoli) ..	1.4–2.0.
Late Varieties (Major, Wannon) ..	1.7–2.5.

A measurement to which a good deal of attention has been paid in connexion with these census investigations is the percentage survival of stools per plant in spring to heads per plant at harvest. This figure for the three classes just quoted would be about 43-50, 35-42, 33-40 per cent. respectively. It is suggested that this is a useful indication of drought resistance. Practically all the successful productions in Victoria of recent years have shown an improvement in this figure over the older varieties. Usually the former have been bred from these old strains (e.g., Federation and Yandilla King) with an outcross of Indian "blood." With the improvement in this characteristic, earliness has previously gone hand in hand, and these new varieties are nearly all of early or mid-season type. A similar improvement in the later varieties is a task for the future.

Ear Size and Grain Weight.

3 and 4 "n" and "g."

Having briefly considered "p" and "e" of the four yield factors the remaining two harvest determinations of "n" and "g" remain for discussion.

At the harvest count after the number of plants per foot and ears per plant have been noted and recorded, the heads are thrashed, and the average yield per head determined. Counts are then made on the thrashed grain sample for average weight of grain "g." Then the figure previously determined for average yield per head (in grams) is divided by "g" to give "n" the average number of grains per head.

The observations over the past three years, however, have found these measurements to be approximately of th following dimensions:—

Average Yield per Head ..	.3–.9 grams per head.
Average Number of Grains per Head	10–23 grains.
Average Weight of Grain ..	35–45 grams per 1,000 grains

The same variation with variety and environment, noted in the case of "e," has been observed in connexion with these two characters. The Rate of Seeding test quoted above furnishes a good illustration of environmental variation as produced by different spacing conditions. The figure for Average Yield per Head moves from .98 grams to .68 grams between the rates of seeding of 45 and 180 lb. per acre. Under similar conditions the Average Number of Grains per Head goes from 22.6 to 15.6. Weight of Grain, "g," however is more dependent on variety and seasonal conditions, and does not vary to anything like the same extent.

As to the varietal variation in regard to "n" and "g" a general statement concerning typical differences between early, mid-season, and late varieties cannot be made. Up to the present in this study we have been almost completely in accord with Howard and Howard (9), who suggest the following correlation in the growth of the wheat plant, viz., a positive correlation between length of growing period and size of the yield factors "e," "n," and "g," and vice versa, i.e., late varieties tend to have more ears per plant, more grains per ear, and larger grain. We are completely with them as far as "e" is concerned. Very probably also the correlation would hold in regard to "n" and "g" in a comparison between the universally early wheats of Australia and the late or winter wheats of England. In a comparison between the early and late wheats of Australia, however, the statement cannot be generally applied. Of the varieties studied in Victoria we have found an early variety with a very large "n" factor, and another with "g" of a very satisfactory size.

For this state of affairs we have to congratulate the plant-breeder on the combination of characters that has been achieved in the past, and from it we take courage for further developments along this line in the future.

Spikelet Count.

At the harvest count before thrashing the heads, a spikelet count is usually made on a representative sample of them for Total Spikelets per Head (Fertile and Sterile). No general figures can as yet be quoted for these observations, but the following are the averages for Federation and Free Gallipoli, at Werribee in 1929:—

—	Free Gallipoli.	Federation.
Sterile at tip	·2	1·4
Fertile	11·3	12·8
Sterile at base	5·3	3·8
Total per head	16·8	18·0
Average number of grains per fertile spikelet ..	1·77	1·52

Seasonal Conditions.

This general discussion may be concluded by a note on the way in which the weather conditions affect the four yield factors in the Victorian wheat crop.

Weather in	
May-June-July ..	.. Important effect on germination. "p."
July-August ..	.. Important effect on the basal framework of the plants, in the regard to the strength of the three main stools.
September-early October	.. Practically controls survival of stools to heads. "e."
October-November..	.. Chief effect is on "n." Dry weather and hot winds at this period often result in "tipping" with severe reduction in number of grains per head.
November-December	.. Seasonal conditions in these two months largely control "g."

Accuracy of Results.

Certain investigations on accuracy in field trials conducted at Werribee in 1926-27 (8) showed that the same attention to this matter was required under Australian as under English conditions. Since then it has been the practice to adopt approved English methods almost without question. As this method of census investigation was developed and approved by such statistical authorities as those of the Cambridge School of Agriculture, it has not been thought necessary to go deeply into the accuracy of the various results. Calculations, however, on the figure for population—the most variable of the four factors—show the probable error of the mean of 200 samples to lie between 1.5 and 2 per cent., and to the measurements of the other yield factors even a greater degree of accuracy is attached.

Acknowledgment.

This inquiry has been instituted as part of our departmental work under the direction of Mr. H. A. Mullett, Agricultural Superintendent, and we wish to record our thanks for the scope given and the facilities provided. We have also been extremely fortunate in having Professor S. M. Wadham as a guide, counsellor, and friend, associated as he was with Engledow in this type of investigation at Cambridge; and we wish to tender our sincerest thanks for his kindness.

Every acknowledgment is made to Mr. F. L. Engledow, the work reported being merely the results of the Victorian observations along the lines originated and developed by him at Cambridge, and reported (2. 3. 4. 5. 6. 7) in various articles on "Investigation on Yield in Cereals."

APPENDIX.

As stated earlier any detailed consideration of the results obtained during the course of the Crop Census Investigations would not be attempted in this article. In this appendix, however, are included two sets of data as typical of that obtained in this type of inquiry.

Crop Census Investigations, Werribee, 1929.

SUMMARY OF FIGURES FROM VARIETAL CENSUS ACRES.

—	Rajah.	Free Gallipoli.	Ranee.	Federation.
HISTORY OF PLANTS. (Germination to Harvest.)				
Number of grains sown per foot	14·8	14·6	15·6	14·7
Number of plants per foot at germination	10·26	11·18	11·29	10·32
Percentage germination	69	77	70	72
Number of plants per foot at stooling	9·80	10·88	11·20	9·41
Percentage survival of plants from germination to stooling	97	94	99	93
Number of plants per foot at harvest	9·05	9·45	10·01	7·77
Percentage survival of plants from germination to harvest	87	87	89	78
Plants per foot at harvest / Grains sown per foot (per cent.)	61	65	64	53
HISTORY OF STOOLS AND EARS.				
Total number of stools per foot (Sept.)	23·92	28·67	28·69	32·43
Average number of stools per plant	2·44	2·64	2·56	3·45
Total number of ears per foot (Dec.)	13·53	14·43	17·24	13·69
Average number of ears per plant	1·50	1·53	1·73	1·76
Per cent. survival: heads per foot / stools per foot	57	50	60	42
Per cent. survival: heads per plant / stools per plant	61	58	68	51
SIZE OF HEAD.				
Average yield per head (gms.)	·83	·75	·61	·64
Average number of grains per head	22·0	20·0	15·4	19·5
Average weight of grain (grams per 1,000 grains)	37·6	37·5	39·3	33·0
SPIKELETS PER HEAD.				
Sterile at tip	·3	·2	·1	1·4
Fertile	11·5	11·3	9·3	12·8
Sterile at base	3·9	5·3	3·8	3·8
Total per head	15·7	16·8	13·2	18·0
Average number of grains per fertile spikelet	1·91	1·77	1·61	1·52
YIELD PER ACRE.				
Yield per acre calculated from the above Census figures (bush/ac.)	30.8	29.8	28.7	24.1

Rate of Seeding: 90 lb. per acre. Super: 168 lb. per acre. Sown 11th May, 1929.
Rainfall during growing period, May–November (100 points = 1 inch): May, 117; June, 83; July, 123; August, 185; September, 113; October, 157; November, 214. Total 992 points.

These observations were obtained from Varietal Census Study similar to that described in the preceding pages. The varieties studied, included two early, Rajah and Ranee, and two mid-season varieties, Free Gallipoli and Federation.

The figures relating to the history of the plants from germination to harvest are first tabulated. It will be seen that all the varieties move together through the season until late spring, when a rather serious loss of plants is recorded in the case of Federation, due to Fusarium attack.

The dry conditions prevailing for some weeks after germination—1st June—severely restricted early growth and stooling is very low in

the case of Free Gallipoli and Federation, the mid-season varieties. With the early varieties Rajah and Ranee stooling is approximately normal. However, improved conditions later in the spring allowed an abnormally high percentage survival of stools to heads, and these heads, due to a cool, moist November, matured slowly, and very satisfactory figures were recorded for the yield factors "n" and "g." All measurements of these characters may be regarded as typical for the varieties concerned with the exception of "g" for Rajah, which is rather higher than usual on account of the late season.

A modification of the original census procedure has been made in what we have called "The Flying Census." This method is used on small experimental plots, and consists of drawing a requisite number of samples from the plots in December. In consequence only a harvest count is obtained. The unit sample is 1-foot length of drill row as before, and 50 such, systematically scattered over a one-tenth acre plot, have been found to give a sufficient degree of accuracy.

Typical figures obtained from such a Flying Census are as follow:—

CROP CENSUS INVESTIGATIONS, WERRIBEE, 1929.

Summary of Figures from the Manurial Tests.

	Manurial Treatment.			
	No Manure.	Super. ½ cwt.	Super. 1½ cwt.	Super. 2 cwt.
PLANTS.				
Number of plants per foot at harvest	5.45	8.13	7.72	7.75
EARS.				
Total number of ears per foot	5.67	10.90	12.40	14.00
Average number of ears per plant	1.04	1.34	1.61	1.80
SIZE OF EARS.				
Average yield per year (grams)	.40	.84	.86	.88
Average number of grains per head	11.6	18.5	20.1	20.9
Weight per 1,000 grains (grams)	34.4	45.5	42.7	42.1

These census observations serve to illustrate three definite effects of superphosphate:—

1. The increased survival of plants from germination to harvest on the plots receiving the fertilizer, an increase, however, which is not continued with the heavier applications.
2. The increase in number of ears per plant with increasing applications of superphosphate.
3. The increase in size of head on the plots receiving superphosphate, an improvement, however, which again is not appreciable with dressings above the initial half hundredweight per acre.

It would seem, therefore, that the chief effect of superphosphate in increasing yield of wheat at Werribee lies in the improvement it gives

in density of crop by increasing "p" and "e." Improvement in size of head while noted in the case of the lightest dressing is not an important factor in the increased yield given by the heavier applications.

We also include the complete data from the Rate of Seeding test, which have been used so freely in this paper.

Crop Census Investigations, Werribee, 1929.

SUMMARY OF FIGURES FROM THE RATE OF SEEDING TEST.

—	Rate of Seeding.					
	45 lb.	60 lb.	75 lb.	90 lb.	120 lb.	180 lb.
HISTORY OF PLANTS. (Germination to Harvest.)						
Number of grains sown per foot ..	6	8	10	12	16	24
Number of plants per foot at stooling ..	4·68	6·38	7·93	9·45	11·85	..
Percentage survival of plants from seeding to stooling	78	80	79	79	74	..
Number of plants per foot at harvest ..	4·50	5·90	7·46	8·42	10·82	13·50
Plants per foot at harvest / Grains sown per foot } per cent. ..	75	74	75	70	68	56
HISTORY OF STOOLS AND HEADS.						
Total number of stools per foot (Sept.)	35·9	39·2	44·8	45·7	47·0	..
Average number of stools per plant ..	7·44	6·22	5·70	4·96	3·96	..
Total number of ears per foot (Dec.) ..	14·0	15·2	15·2	16·1	17·2	15·7
Average number of ears per plant ..	3·12	2·58	2·10	1·91	1·59	1·16
Per cent. survival { heads per foot / stools per foot } ..	40·2	38·7	34·2	35·1	36·6	..
Per cent. survival { heads per plant / stools per plant } ..	41·8	40·4	37·2	39·7	40·1	..
SIZE OF HEAD.						
Average yield per head (gms.) ..	·98	·88	·88	·75	·75	·68
Average number of grains per head ..	22·6	20·6	19·7	17·9	16·8	15·6
Average weight of grain (grams per 1,000 grains)	43·3	43·7	44·6	42·0	44·7	43·6
SPIKELETS PER HEAD.						
Sterile at tip	·3	·8	·8	1·3	1·1	1·7
Fertile	14·0	12·7	12·6	11·7	11·1	10·3
Sterile at base	5·6	5·9	5·9	6·1	6·3	6·0
Total per head	19·9	19·4	19·2	19·1	18·5	17·0
Average number of grains per fertile spikelet	1·61	1·58	1·57	1·53	1·51	1·51
YIELD PER ACRE.						
Yield per acre calculated from the above Census figures (bush/ac.) ..	37·8	36·8	36·8	33·2	35·5	29·4

Variety: Free Gallipoli. Super: 168 lb. per acre. Date of Seeding: May 1st, 1929.

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POULTRY DISEASES.

III.—FOWL-POX.

By Harold E. Albiston, D.V.Sc., Veterinary Research Institute, Melbourne University.

Investigations into the nature of fowl-pox during the last few years have demonstrated in a striking fashion that several abnormal conditions of poultry, formerly thought to be distinct diseases, are in reality merely different manifestations of the same disease, and due to the same cause. It has been shown that fowl-pox may assume several forms, either in different birds in the same outbreak, or in different outbreaks. Occasionally all forms may develop in one bird. Prior to our more complete understanding of the disease, the different manifestations of fowl-pox were assumed to be distinct diseases. As a result, a number of terms, each intended to be more or less descriptive of one of the forms of fowl-pox, appear in the literature dealing with diseases of poultry, e.g., *avian diphtheria, contagious epithelioma, infectious coryza, chicken-pox,* and *roup.* These terms, however, do not refer to individual diseases of birds, but to the various conditions which may develop in birds infected with the virus of fowl-pox. Where this virus is the cause of disease in birds, the disease should be termed *fowl-pox,* irrespective of the form it may take.

Cause.

Fowl-pox is an infectious disease of birds, caused by an organism belonging to the group of filter-passing microbes, or filterable viruses. These viruses are so minute in size that they are capable of passing through the pores of special filters which are impervious to bacteria. Included in the group of filterable viruses are the causal agents of small-pox, cow-pox, foot and mouth disease, and several other well-known infectious diseases of animals and birds.

Susceptibility.

Fowl-pox may affect a variety of birds, but it is economically most important when it occurs among chickens and fowls. Turkeys and

pigeons are also commonly affected, whereas outbreaks among ducks and geese are only occasionally seen. Cases have been described in certain wild birds (quail).

Signs of the Disease.

As indicated previously, fowl-pox may make its appearance in several clinical forms which may be conveniently tabulated as follows:—

A. Eruptive form with the development of wart-like nodules or papules on the comb, wattles, and the more lightly-feathered parts of the body (contagious epithelioma, chicken-pox).

B. Diphtheritic form where false membranes, or diphtheritic inflammatory exudates develop on the mucous membrane of the mouth and upper air passages (avian diphtheria, roup).

C. Oculo-nasal form indicated by inflammation of the eyes and nasal passages. (Infectious coryza).

A. Eruptive Form.—The eruption makes its appearance on the comb, wattles, eyelids, and the corners of the mouth; in certain cases, the undersurface of the wing may also be affected. The first manifestation is the appearance of a series of small whitish pimples or papules which gradually enlarge. A yellowish crust forms on the summit of each papule, producing a cauliflower-like growth, the size of which increases up to the tenth day. The colour of the crusts then gradually darkens to a brownish or black hue, and they form into hard dry scabs. At the end of two or three weeks, these scabs are easily removed, leaving a raw surface which heals quickly with little or no scar formation. The virus of fowl-pox is present in these scabs, which may retain their infectivity for many months or even years.

B. Diphtheritic Form.—This form commences with an inflammation of the mucous membranes of the mouth and pharynx, which are at first reddened; in a short time a yellowish cheesy exudate or diphtheritic membrane forms, at first in scattered patches, but in bad cases extending over the greater part of the lining of the mouth and pharynx. The nasal passages may become similarly affected, and the diphtheritic deposit is frequently seen projecting into the mouth through the cleft in the hard palate. The obstruction to the passage of air through the nostrils by the cheesy exudate results in mouth breathing, and the constant passage of air over the tongue causes the latter organ to dry, especially at the tip, producing the condition known as the "pip." One very distinctive characteristic of the diphtheritic form of fowl-pox is the peculiarly repulsive odour which is emitted in the breath of an affected bird.

C. Oculo-nasal Form.—This phase of fowl-pox is frequently ushered in with a discharge from the nostrils, at first watery and later becoming thick and tenacious. One or both eyes may show a sticky discharge which tends to gum the eyelids together. A cheesy exudate gradually forms around the eyeball in the conjunctival sac, causing a marked swelling of the orbit, and in serious cases it may be accompanied by inflammation of the eye itself with subsequent blindness. The accumulation of the cheesy exudate in the nostrils and orbit frequently results in a distortion of the bony structures of the face with a consequent lasting deformity.

As a rule, in a serious epidemic of fowl-pox, all forms may be present in different birds, and in a few cases, the same bird may develop each type of the disease. There is a tendency, however, for one or other of the forms to predominate at different times of the year. For instance, the eruptive form is usually seen in outbreaks occurring in the warmer seasons, whereas the diphtheritic and oculo-nasal forms are most common during the cold winter months.

Age Incidence.

It is generally recognized that birds of all ages are susceptible to the disease, unless they have previously recovered from an attack. It is rarely seen among very young chickens. Usually the disease makes its appearance soon after the birds are placed in the laying pens, and as a rule, it spreads quickly through the young flock. The mortality rate varies considerably. It seems probable that the virulence of the virus varies from time to time in different outbreaks, and this factor alone has a marked bearing on the mortality rate. Fowl-pox is usually most serious when the diphtheritic form predominates—for instance, during the winter months—and up to 80 per cent. of the affected birds may die.

Symptoms.

The actual symptoms shown vary according to the form the disease takes; mild cases may show only slight disturbances of health. In acute cases, the birds quickly show dullness and depression. They tend to mope about, quite indifferent to their surroundings, and the appetite is frequently poor. There is usually some fever, and in many cases diarrhoea is present. When the eyes become affected in the oculo-nasal form, death may be hastened through the failure to discover food owing to blindness. As the disease progresses, the affected birds become much debilitated and emaciated, and death takes place from exhaustion. In the diphtheritic form, the absorption of poisons from the diseased tissues has a marked deleterious effect on the constitution of the birds.

When the diphtheritic membranes form near the opening into the windpipe or inside the larynx, death may occur quite suddenly through the exudate occluding the air passage and producing suffocation.

Diagnosis.

The diagnosis of fowl-pox can readily be established by the discovery of the closely adhering yellowish diphtheritic membranes in the mucous membranes of the mouth, pharynx and air passages, and by the characteristic wart-like nodules or pox on the comb and wattles.

Methods of Spread.

The apparently spontaneous appearance of fowl-pox which is so characteristic of the disease has given rise to the theory that birds which have recovered from an attack become "carriers," harbouring the virus in their systems, and when introduced into a clean flock they may provide the infection for a new outbreak. Research work conducted by Doyle and Minett in England has shown that this theory is untenable, and that the virus of fowl-pox can never be demonstrated in the body of a fowl recovered from the disease.

As the result of their experimental work, these two workers concluded that direct contact between healthy and diseased birds was necessary for the spread of the disease. They were able to demonstrate that the virus of fowl-pox would not penetrate the *unbroken skin* and *mucous membranes,* and therefore they postulated that the infection of the skin of the comb, wattles, &c., results from injuries sustained in fighting, and that wounds in the mouth, produced by sharp grit, provide the portal of entry of the virus into the mucous membranes.

An important discovery was recently made in America, where it was shown that fowl-pox may be transmitted from bird to bird through the agency of mosquitoes. These insects were found to be infectious immediately after sucking blood from an affected bird, and in one case, a mosquito was capable of transmitting the disease a fortnight after becoming infected. One investigator showed that he was able to rear chickens free from fowl-pox by keeping them in pens protected by fly-proof screens.

It is probable that mosquitoes play an important role in the introduction of fowl-pox into a flock of birds. The greater susceptibility of breeds with large combs and wattles, the tendency of the disease to spread in the direction of the prevailing winds, the appearance of the disease in chickens reared from the day-old stage on new premises, and the protection afforded by fly-proof screening, all tend to support the theory that the extension of fowl-pox is frequently due to mosquitoes. It is certain, however, that once the disease has been introduced, its spread through a flock may take place independent of mosquitoes through the agency of wounds.

Control.

One of the outstanding features of infections with certain filterable viruses, especially those characterized by pox eruptions, is the strong immunity to subsequent infections which develops following recovery from an attack of the disease. This phenomenon is the basis of the artificial immunization of susceptible animals by vaccination and the value of the vaccination of human beings against small-pox is common knowledge. It is generally accepted, however, that artificial immunization against a disease due to a filterable virus can only be practised with a living virus, altered or modified in some way so that its inoculation into a susceptible individual results in the production of immunity although the reaction produced is mild and harmless.

Fowls recovering from a natural attack of fowl-pox are generally found to be immune, and attempts at control have been made by the use of a vaccine containing the virus. It must be pointed out, that the artificial immunization of birds against fowl-pox is still in the experimental stage; there is no doubt, however, that a valuable product will ultimately be found which will be safe to use, and produce an immunity sufficiently powerful to prevent the disease. At the present time, a vaccine is prepared by the Commonwealth Serum Laboratories, Royal Park, and information regarding its use may be obtained from the director of the laboratories.

Apart from the use of vaccine, certain measures should be adopted to prevent the introduction of the disease into healthy flocks. Newly-purchased fowls, or birds which have been returned from shows and

egg-laying competitions, should be properly isolated for at least a fortnight before being placed with the other fowls. The use of fly-proof screening is recommended where financial considerations allow it. In the event of the disease breaking out, the affected birds should be immediately isolated, and when few in number, it would be sound policy to destroy them and burn the carcasses. Disinfection of the hands and boots should be practised by those handling infected birds.

No medicinal treatment has been found of any avail, as the course of the disease cannot be checked once a bird has become infected. As the virus shows a marked tenacity to life, thorough disinfection of premises in which infected birds have been housed, must be undertaken.

INCUBATION.

By W. Pederick, Assistant Poultry Expert.

Incubation is one of the most interesting, and also one of the most important operations in connexion with poultry-keeping. The poultryman depends chiefly upon the pullets for the supply of eggs during the winter months; it is, therefore, advisable for him to replace a large proportion of the laying flock each year with pullets. This replacement makes the use of artificial methods of incubation absolutely essential. It is estimated that for every six eggs laid by the breeding stock only one pullet is reared. Wastage takes place in the following way:—For every six eggs gathered, one is discarded on account of size, shape, or shell texture; one for infertility; one because of weak germ or "dead in the shell"; thus three eggs are rejected. Of the chicks that will be hatched from the remaining three eggs, one may be set down as a cockerel, and of the remaining two one will probably be lost by accident, disease, &c. This shows that the replacement cost is very heavy; consequently it is necessary to attend to every detail that is likely to affect it in any way.

Hatching chicks successfully in an incubator depends on a number of circumstances, quite apart from the actual operating of the machine. Some of the factors which influence the hatch are:—The vigour of the breeding stock, their care and management, selection of hatching eggs, storage of hatching eggs, time when eggs are set, and incubator management.

Selection of Breeding Stock.

The careful selection of the birds intended for breeding will eliminate many poor layers and weak individuals. The selection should take place several months before the breeding season commences. This will give the poultry-keeper an opportunity to prepare the birds for the breeding season. Early moulters are looked upon with suspicion; late moulters are usually the most desirable birds from which to breed. Of course, no bird should be permitted to lay right through the season unless she has moulted. If she continues to lay, production should be stopped and the bird allowed to moult, so that she may be back again when the early breeding season commences. During the moult, the birds' reproductive organs have a complete rest, so the first 20 or 30

eggs laid after the moult are the ones most likely to hatch good strong chicks. Only hens one year old or over should be used for breeding. Breeding from immature pullets will usually result in weak chicks and smaller eggs. It is very important to know how the male bird is bred, and he should be well developed with plenty of constitutional vigour.

Breeding stock should have been well fed during the winter. In general, the ration which is recommended for layers is satisfactory for breeders. Ample supplies of good succulent green feed should be supplied, and, if possible, skim milk or dried butter-milk. The feeding of milk and greenstuff is known to have a good effect on the stock themselves and on their eggs. The ideal breeding pen is one wherein the birds are allowed free range. If they must be housed, they should be allowed as much room as possible, and be supplied with plenty of clean scratching material to provide exercise. The house should be so constructed that the direct rays of the sun can shine on the birds. Direct sunlight on breeding stock has an important beneficial effect upon fertility and hatchibility of eggs.

The number of hens that should be mated to each male bird varies with the different breeds, and is also dependent on the varying conditions under which birds are kept. The more freedom they have the greater the number of hens that can be mated to each male. With White Leghorns, twelve to fourteen hens can be mated to one male; with Australorps, Rhode Island Reds, and Light Sussex, from eight to ten.

The Selection of Eggs for Hatching.

Eggs suitable for hatching should be selected from those gathered each day. The hatching of many crippled, deformed, and "dead-in-the-shell" chicks could be prevented if only normal-sized, good-shelled, and good-shaped eggs were set. The ideal hatching egg should weigh not less than 2 ounces, and have a smooth shell of medium thickness, and be free from ridges or roughness. Thin-shelled eggs dry out rapidly, and thick-shelled eggs do not permit good circulation. Those of normal shape are desirable. There is no foundation for the ancient idea that long eggs will hatch cockerels, and short round eggs hatch pullets. In fact, there is no way to predict the sex of the chick from observation of the egg. On the average, half the eggs will hatch cockerels and half pullets.

Eggs of stud stock should be gathered frequently, especially in bad weather. Daily gathering will prevent the necessity for cleaning the eggs, which takes a great deal of time, and may affect hatchibility. Very dirty eggs should be cleaned before being placed in the machine; but it is preferable to have the eggs taken while clean from the nest.

Eggs that are being held for incubation should be stored in a cool, well-ventilated room. Scientists tell us that incubation commences, or at any rate that change will begin to take place, in an egg at a temperature as low as 68° F. It is probable that eggs are not injured for hatching purposes if they are stored where the temperature does not go below 40° F. A temperature of between 55° and 65° should be ideal. The length of time that eggs may be held and still hatch reasonably well is debatable, but there is no doubt that the fresher they are the better. It is advisable to use eggs not more than about 7 days old.

Hatch Early.

The result of years of experience on the Research Farm, Werribee, has shown the advisableness of hatching early. There are many advantages gained by doing so. Surplus cockerels may be sold on a higher market. Pullets develop well in the early spring, and are better able to withstand extreme heat in the summer; they also mature quickly and begin to lay when egg prices are improving. Late-hatched chicks are hard to rear; they are slow in maturing, and the pullets do not begin to lay until late in the winter when egg prices are declining. While some early-hatched pullets have a tendency to go into a false moult in the early winter, they more than make up for the short time lost by an increased number of eggs in the late summer and autumn. This false moult does not usually affect the entire flock, and experiments have shown that it can be checked by feeding a large proportion of grain, or by allowing free choice of grains during the autumn and early winter.

The months most suitable for hatching are July, August, and September. At the Research Farm, no chicks are hatched after 30th September.

Operating the Incubator.

Before the hatching season starts, the incubator should be examined, and any missing or broken parts replaced. The heater must be free from soot or dust. The lamp should be thoroughly cleaned, and the burner boiled in soap-suds to remove any oil or carbon. A new wick should be obtained at the beginning of the season, and be of such quality that it will not require replacement during the season. The machine should then be connected and made perfectly level, and given a trial run to see that all the parts are in working order.

The instructions supplied by the maker of the machine should be studied carefully, and at least followed fairly closely. Conditions, of course, vary in different districts and in different rooms; therefore, regulations cannot always be rigidly observed, and they must be varied to meet circumstances. To operate an incubator successfully, one should keep in mind three essentials: heat, fresh air, moisture. The best development of the chick-embryo takes place when these are present in proper proportions.

By experience, it has been found that the correct temperature for incubating hen eggs is from 103° to 104.5°. The temperature should always be read with the bulb of the thermometer just 2 inches above the tray on which the eggs are placed—that is, just a little above the top of the eggs. As the temperature varies at different levels in the egg chamber, it is most important that the readings be made at a constant level. The further away from the source of heat, the lower the temperature, and vice versa. At the commencement of the season, the thermometer should be tested by a chemist, or one may do it himself by comparing it with a clinical thermometer. If it is not registering correctly, allowance can be made accordingly. Best results are obtained when the machine is operated at 103° for the first week, 104° for the second, and 104.5° the third week. To maintain an even temperature,

the machine should be operated in a room which is not affected greatly by outside temperature. Care should be taken that the sun does not shine directly on the machine, and thus raise the temperature.

Like any other growing thing, the chick-embryo needs oxygen, which it obtains from fresh air. To ensure a regular supply of fresh air in the machine, the incubator room, as well as the machine itself, must be well ventilated. An incubator room built on the ground level is preferred to a cellar, because it is much easier to ventilate. Many instances have been brought under my notice where bad ventilation has been the direct cause of poor hatches—the chicks dying in the shell. Often, in the endeavour to keep the incubator room at an even temperature, the ventilators are closed, but, in my opinion, the lack of fresh air does more harm than a slight variation in temperature.

Incubators are constructed on many different systems—hot-air, hot-water tank, hot-water pipes, &c.—but in all of them a circulation of air through the machine is necessary. If the exchange of air is too rapid, the eggs will dry out. This tendency must be corrected by supplying moisture.

It is very difficult to determine the exact amount of moisture required. Mechanical devices which are supposed to indicate the evaporation from the eggs are seldom reliable. It is advisable to do a little experimenting, until one finds the amount of moisture that will give the best results under one's own conditions. For beginners, I would suggest that they supply moisture during the whole of the hatch. It is doubtful whether too much can be supplied, but we do know that insufficient moisture is harmful. The usual method of applying the moisture is by placing a tray of clean water in the machine, but probably better results are obtained by keeping the floor of the incubator-room damp. As evaporation takes place, the moisture-laden air passes into the machine.

Before each hatch, the incubator should be thoroughly scrubbed and disinfected with a good strong disinfectant, such as formalin. It has been definitely proved that some of the worst diseases affecting chickens can be spread by the agency of the incubator; hence the importance of this measure.

The greatest care must be taken of the oil lamp. The wick should be trimmed regularly each day, so that an even flame is produced. A smoky flame will cause soot to form, and soot may cause fire. It is a good practice to fill the lamp and clean the wick in the morning after handling the eggs. Handling the eggs with oily hands is one way to get a poor hatch. The lamp should never be completely filled with oil, about a quarter of an inch of space should be left in the top of the bowl; this will prevent the oil from running over after it warms up and expands. The chimney should fit firmly on to the burner; one should be on the watch for cracks or breaks in the mica of the chimney, as these are often the cause of a smoky lamp.

The machine should be regulated and running nicely for a few days before the eggs are put in, but it must be borne in mind that it is harder to keep an even temperature in a empty machine than in one filled with eggs. Putting in cold eggs will, of course, cause the temperature to drop, and several hours may elapse before it can be brought back to normal.

When running at the desired temperature, the regulating damper should be hung about an eighth of an inch above the chimney; it is then in the best position to operate against a rise or fall in the temperature.

Turning the Eggs.

The machine should not be opened for the first two days. To prevent the chick-embryo from sticking to the shell, and to enable it to grow evenly, it is necessary to turn the eggs regularly from the third to the eighteenth day. Where automatic turning devices are installed, and the turning can be done without affecting the temperature, the eggs should be turned five or six times a day; but where the turning is done by hand, it is not advisable to turn more than two or three times daily. A good method of turning is to take two or three rows of eggs off one side of the tray, and roll the others over gently into the vacant places with the palms of the hands; then put the eggs which were removed in the first instance in the places of those which were turned over by hand. This brings about not only an effective turning, but it alters their position on the tray. It is advisable to reverse the tray each time it is replaced in the machine.

Cooling.

The question of cooling is a much debated one, and some poultrymen claim to get good results without cooling. The usual practice, and the one that I have always followed, is to cool the eggs once a day from the third to the eighteenth day, the time of cooling ranging from about 5 minutes to 25 minutes. Cooling causes the contents of the egg to contract slightly, and fresh air is drawn in through the pores of the shell to the growing chick.

Testing Eggs.

Eggs should be tested twice during the hatch—on the sixth and the fourteenth days. An infertile egg looks quite clear when held before the light. If the egg is fertile, a number of pink lines will be seen to radiate from a dark spot in the centre. A dead embryo at this stage will appear as a dark spot within a faint circle, and no lines radiating from the centre. The second test should show up the remaining dead germs.

The eggs should be turned and cooled for the last time on the evening of the eighteenth day. The machine should not be opened again on any account until the hatch is practically complete.

While the chicks are hatching, a dark cloth may be hung over the front of the machine to shut out the light, and thus prevent the newly-hatched chicks from scrambling forward over the others that are chipping.

On the evening of the twenty-first day, the chicks may be allowed down on the nursery tray, and by the twenty-third day they should be ready to go into the brooders.

There is no need to specify the many advantages that artificial incubation has over the natural method of hatching, but the greatest success in using the incubator will be achieved only by following as closely as possible the habits of the broody hen.

THE EXPORT OF EGGS.

By W. C. Rugg, Chief Poultry Expert.

The present economic position is being so widely discussed, that it is hardly necessary for me to point out to the poultrymen of Victoria that it is vital to the very existence of their industry that they should do their part in helping to restore the balance of trade.

I am well aware that the export of eggs last season was not profitable; the losses, however, were to a certain extent offset by the better prices obtained on the local market. These prices would have been a great deal better had Victorian poultrymen exported as many eggs as some of the other States, instead of selling them to speculators for cool storage and for sale on the markets of other States, where the poultrymen made sacrifices to ensure Australia's export season of 1929 being a record.

We are all liable to make mistakes, but I sincerely trust that Victorian poultrymen will not again fall into a similar error. Over ten years ago, I heard a now prominent member of Parliament return thanks to his constituents the first time he was elected. In his speech he said, amongst other things, "I expect to make mistakes, but one thing I will promise you, and that is—I'll never make the same mistake twice." And I am hoping that Victorian poultrymen will not make the same mistake twice.

The Export of the Past Three Seasons.

For many years past, officers of the Department of Agriculture have tried to impress upon poultrymen the necessity for building up an export trade in eggs, but their efforts have met with very limited success. In the year 1925, after travelling over most of Victoria, I wrote an article, which was published in this *Journal,* drawing poultrymen's attention to the great increase taking place in the number of birds being bred for egg production, and pointing out that the time had arrived when those engaged in the poultry industry should give serious consideration to the development of an export trade. This article was given a great deal of publicity, and was followed by others in the press—all advocating the export of as many eggs as possible during the flush season—September to December. Eggs shipped in those months can be landed on the London market when, owing to seasonal conditions, the supplies of English new-laid eggs are very low. Exporters succeeded in shipping 13,000 cases valued at £26,000, which at the time was considered very satisfactory. The following year production increased still more rapidly. The press, officers of the Department of Agriculture, and exporters, again used every effort to induce poultrymen to export as many eggs as possible, and a very satisfactory response was made. Nearly 20,000 cases (each containing 30 dozen eggs) were shipped, which brought approximately £40,000 of English money into Victoria.

The removal of these eggs from the local market resulted in better prices being obtained on the Melbourne market throughout the season,

and many of the large egg producers increased their plants, and a great many new men went into the business, which meant further increased production.

Unfortunately, the enthusiasm for export waned. Many of those who had supported export in the two previous years refused to send any eggs at all, and decided to sit back and take the improved local price. That year, the number of eggs exported fell to a little over 10,000 cases—about half the number sent the previous year.

Speaking in 1928, just before the export season started, I said that I could assure the poultrymen of Victoria that their industry had reached the most critical stage of its existence, and that every one must endeavour to find markets for a greater number of eggs than had ever been produced in Victoria before in one year. Thanks to the press and the efforts of several poultry organizations, nearly 24,000 cases were exported, which was a record for Victoria.

This meant that about £48,000 of British capital was brought to Victoria, and, in addition, it ensured the producers a very much improved price on the local market for the rest of the season.

During the last season, the export dropped to 15,000 cases, which was a disgrace to Victorian poultrymen.

Everybody connected with the industry knew that production was still increasing rapidly, not only in Victoria, but in all the other States, and that it was of the utmost importance to export every exportable egg—yet, out of a total of 119,000 cases exported from Australia, Victoria contributed only 15,000 cases.

The Necessity for Export.

The time has arrived when every poultry-farmer must realize that unless he exports as many eggs as possible during the next four months, we will assuredly see during the spring prices for eggs fall below the cost of production, which will put many of the small producers out of business, and the larger farms will suffer severe financial losses.

On the poultrymen themselves depends the success or failure of their industry. Within the next few weeks they must decide whether they are going to keep their industry in the proud position it holds to-day of being fourth on the list in value of Victorian primary production, or whether they will let it fall away like some of the other industries, and then finally appeal to the Government for bounties or support of some kind to keep their businesses alive.

Continuity of Supply Essential.

The British merchants continually complain of the erratic shipments, and that no effort is made to keep up a continuity of supplies.

We must remember that eggs are going on to the London market from over twenty different countries, and no matter how much the British merchants are inclined to give Dominion goods preference, they, as business men, cannot afford to deal with a country which does not bother to send her goods regularly at the proper season.

No doubt, irregular shipments from Victoria are in a great measure due to lack of organization amongst the poultrymen. Unfortunately, for the industry, there are too many organizations—but not enough *organization.* I believe that these rival organizations are, at least, honest in their endeavour to benefit their members, but the time has arrived when they must sink their petty differences of opinion in a matter that is vital to the prosperity of every one engaged in the poultry industry. Rivalry is a good thing—up to a point; but the members of poultry organizations must realize that the position of the industry to-day is too critical to permit of time being wasted in criticizing one another's methods. They must come together and agree on a policy for finding suitable markets for the ever increasing numbers of eggs that are being produced. This can be done provided that legal standards are laid down for the sale of all eggs and egg pulp, on a quality basis, and that eggs in shell are sold according to grade weights.

What Should Grade Weights be.

There are great differences of opinion as to what those grade weights should be. For a long while the weight of a standard egg has been fixed at 2 ounces. In recipes printed in cookery books nearly 100 years' old, every reference to eggs mentions "eight eggs to the lb.," or "four eggs to the ½-lb. weight." With this standard, surely eggs which weigh more than 2 ounces should bring a special or higher price, and that eggs which weigh less than the standard weight should bring a lower price. Each egg should be sold for what it is worth. If the consumer wishes to buy a dozen eggs, unprincipalled retailers should not be permitted to sell him half a dozen standard eggs and make up the dozen with eggs weighing only from 1¾ and 1½ oz.—and charge him top price. That practice has been going on for years, and no doubt is one of the causes of the restricted consumption by the public.

The Necessity for Grading Export Eggs.

That the failure to grade eggs for sale should obtain in our own State is bad enough, but to find that there are men who have had experience in exporting eggs who advocate the mixing of grades of eggs to send to England, where the best eggs are now sold on definite grade weights, is incomprehensible.

I have just seen some figures submitted by another State to a conference held here, which purport to show that a better price was obtained for small eggs exported to London last year than for the larger ones. These figures indicate that for the 14-lb. pack of ten dozen 1¾ to 2-oz. eggs, 16s. was received, or 1s. 1.71d. per lb. For the 15-lb. pack of ten dozen 1⅞d. to 2⅛-oz. eggs, 17s. was received, or 1s. 1.6d. per lb. For the 16-lb. pack of ten dozen 2-oz. to 2¼-oz. eggs, 17s. 6d. was received, or 1s. 1.1d. per lb.

These figures certainly show that a higher price per lb. was obtained for the pack which contained the small eggs, but no allowance has been made for the fact that the costs—which include cases, grading,

freight, commission, &c.—are exactly the same for the three packs mentioned. It costs at least 6d. per dozen to land eggs on the London market; eggs are packed 30 dozen in the case, thus the shipping costs amount to 15s. per case. The difference in the sizes of eggs in the 14-lb. pack and the 16-lb. pack is so slight that it is possible to pack only the same number of eggs in each case. Therefore, after deducting 15s. from the returns for each case, any increase in price for the larger pack per long 100 must show a more profitable return for the larger eggs.

The price received, less shipping costs, indicates that in a pack of 14 lb. the number of eggs per lb. was 8.57, and their value 9.4d. per lb., or 1s. 1.16d. per dozen.

In the 15-lb. pack the number of eggs to the lb. was eight, and their value was 9.6d. per lb., or 1s. 2.4d. per dozen.

In the 16-lb. pack the number of eggs per lb. was 7.5, and their value was 9.3 per lb., or 1s. 2.88d. per dozen.

Using the figures submitted from New South Wales, it shows that the shipping of the 15-lb. pack is more profitable than the 14-lb. pack by approximately 1d. per dozen, and the 16-lb. pack more profitable by approximately 1¾d. per dozen.

These figures should be fully considered before support is lent to any request to the Commonwealth authorities to alter the grades for export eggs.

Conclusion.

In conclusion, I strongly advise all poultry-farmers to use their influence to bring about the co-operation of the various organizations, so that the costs of export can be reduced to a minimum. Present information indicates that prices are not likely to be so high as in former years, but it is necessary for poultrymen to realize that unless they make this export season a record one local prices for the balance of the year will be low. Better to make a small sacrifice during the short period of export than allow eggs to be piled up in cool stores to come out and compete against new-laid eggs all next winter.

STRANGLES IN HORSES.

By W. M. Lerew, G.M.V.C., Veterinary Officer.

This is a highly infectious disease of horses, and is manifested by a catarrhal inflammation of the nasal passages and by enlargement and abscess formation of the adjacent lymph glands. It is due to the presence of a specific germ (*Streptococcus Equi*) which may be found in the pus of the gland abscesses. It is regarded as a disease of young animals, as the greatest number of cases occur in horses between two and five years of age, although odd ones may appear at any age.

Accessory causes are teething, fatigue, chill, breaking in, and first stabling of young horses, all of which tend to lower the resistance.

The close stabling together of large numbers of horses, as on a sea voyage, is the principal factor in the spread of the disease.

The germs abound in the nasal discharge which will infect the drinking water and the feed, and as they may be found in the manure also, they will contaminate the bedding and prove a source of infection.

Operations, castration, &c., should not be performed on an animal while it is suffering from strangles, as the wound forms a favorable site for the growth of the germ, and may lead to the death of the patient. Healthy animals should not be operated on in premises where strangles are present.

The period of incubation is from three to eight days. One attack of strangles generally gives immunity against the disease, but occasionally an animal suffers a second attack.

Symptoms.

The first symptoms noticed are dulness, the head hanging, eyes partly closed, slight stiffness, and diminished appetite. On examination, the lining membrane of the nostrils will be found to be inflamed, and this may extend to the mouth and eyes as well. The membrane, at first dry, will later give out a watery exudate, and finally a thick opaque discharge of pus which will vary in colour from white to yellow, or may be brown from exuded blood, or greenish from food materials. This discharge generally flows from both nostrils alike. In young animals it is more profuse than in old ones. Early in the attack a swelling may be noticed in the space between the lower jaws; this swelling will be evenly rounded, hot and tender, and later on a small soft spot may be felt in the centre; this is where the abscess will burst and the pus escape; the cavity will gradually heal up, and the recovery of the animal follows. This is the usual course of events in a mild case, but serious complications often occur, and may result in the horse's death.

In more serious cases the trouble may spread from the nose to the throat, causing difficulty in swallowing and a return of ingested liquids through the nose. The extent of the swelling may threaten suffocation. The disease may be spread to the windpipe by pus from an abscess, or by nasal secretions descending into the lungs, or by inhalation of food, and bronchitis may then ensue, followed by pneumonia. Secondary infection in strangles may lead to abscess formation in the abdominal glands. If the abscess bursts into the abdominal cavity death from peritonitis will occur, but in more favorable cases the abscess will burst into the bowel and recovery may follow.

Sometimes the disease attacks the skin, particularly of the face, head, and neck, and appears as small pustules or abscesses; these usually form round the lips, nose, and eyes, or may appear on spots rubbed by the harness.

Prevention.

Prevention of strangles is a difficult matter when the disease is present in the district unless strict isolation of an animal is carried out, but certain precautions may be taken to lessen the risk. Keep young susceptible horses away from contact with strange horses; avoid public stables, and on no account allow animals to drink from public

water troughs. Avoid hay or other fodder from an infected stable, and on no account use harness that has been on affected horses. Before using an infected stable, thorough disinfection must be carried out.

Treatment.

In mild cases, only ordinary hygienic measures are required. Cleanliness, warmth, pure air, and nourishing easily digested food with a plentiful supply of pure water are the chief essentials. Rest is necessary, but exercise may be given in a sheltered yard or paddock in sunny weather. In warm weather it is advisable to keep the patient outdoors altogether instead of stabling him. If the weather is cool, the animal should be rugged. The most suitable food is grass, bran mashes, carrots, scalded oaten hay, and linseed tea. If the bowels are not acting properly two or three ounces of Glauber salts may be given daily in the drinking water. Considerable relief will be given if the nostrils are sponged out with warm water and a little boracic acid, followed by inhalations of carbolic acid or creolin. The easiest method of giving inhalations is to fill a bucket with hot water and add a teaspoonful of the inhalant; put the bucket into a bran bag, and stand it on the ground, holding the upper end of the bag over the horse's nose. This may be continued till the steam ceases to rise from the bucket, and may be repeated several times daily. In some cases dry inhalations will be found of more benefit. For these, instead of the bucket of water, place a hot brick in the bag and pour on it a couple of teaspoonfuls of a mixture of equal parts of turpentine, eucalyptus oil, and Friar's balsam. Allow the patient to inhale the vapour three or four times daily.

Usually the affected animal is troubled with a cough, and this may be relieved by a mixture of camphor, 4 oz., extract of belladonna, 2 oz., and treacle, 1 lb., made into a paste or electuary, and applied to the back of the tongue by means of a flat strip of wood.

If the abscess is slow in coming to a point, it may be hastened by the application of linseed meal poultices to which a little creolin has been added. This may be kept in place by a many-tail bandage. If it is not convenient to apply poultices, stimulating treatment such as rubbing with turpentine liniment, &c., or the application of a light blister will help to bring the abscess to a head.

As soon as a soft spot can be detected a free incision with a sharp knife should be made to allow the pus to escape. Wash out the cavity with some antiseptic, such as a 2½ per cent. solution of creolin, or lysol (one tablespoonful to one pint of water), till the opening heals up. The fever usually subsides when the abscess has been drained. All that is required then is nursing and rest, and a complete recovery may be looked for. If any of the various complications of the disease set in, the skilled attention of a veterinary surgeon should be sought at once.

Vaccines.

Preventative and curative treatment may be carried out by a veterinary surgeon by the use of vaccines. This will prove specially valuable in the case of young thoroughbreds with important racing engagements ahead of them. Vaccination is a very wise precaution to take before shipping horses for a sea voyage.

LAMINITIS OR "FOUNDER" IN HORSES.

By S. A. Mountjoy, L.V.Sc., Veterinary Officer.

The term laminitis is used to describe an acute, sub-acute or chronic inflammatory condition of the fleshy leaves which are found beneath the wall of the hoof and covering the coffin bone. Usually the front feet only are affected, but the trouble may occur in the hind feet as well. Usually the hind feet are affected only at the same time as the front feet.

Cause.

Laminitis is most commonly found in animals with badly formed, flat and pointed feet, and the following are some of the conditions that may bring on an attack:—

Mechanical irritation of the sensitive structures, usually from overwork. Continuous standing, especially as a result of painful lameness (a horse very lame on one leg will take most of the weight on the sound leg, which often "founders" as a result.) Unskilful shoeing, or shoes left on too long. Working bare-footed horses on hard roads. Rapid work after a spell, either in the stable or at grass. Cases of laminitis in horses at grass are fairly common, particularly in ponies. It is especially common after a long sea voyage, unless care is taken to graduate the exercise after landing. Erorrs in diet, such as overfeeding with wheat, oats, or barley, especially when given "new" to animals not accustomed to them, may bring on an attack. Wheat is particularly dangerous.

Finally, laminitis may occur as a complication of colic, during convalescence after pleurisy, pneumonia, influenza, and after foaling (particularly in cases after retention of after-birth), and also as a sequel of severe purgation.

Symptoms and Diagnosis.

The most prominent symptoms are heat and pain in the affected feet, and severe lameness. The animal stands still, and is unwilling to pick up either foot, as the pain in the other is thereby greatly increased. The affected feet are thrust far forward so as to take as much weight as possible on the heels. The patient is not inclined to move, and when forced to do so the heels of the affected feet are markedly brought to the ground first. After a little exercise the pain is not so severe and the action improves.

Although the disease is very painful, animals usually remain standing, but the severe pain sometimes forces the horse to lie down continuously. In some cases the coffin bone perforates the horny sole, the foot becomes septic and the animal is unable to stand, and death may occur from exhaustion.

Displacement of the coffin bones can be detected on examination of the sole, which will be found to be flat or convex, instead of concave.

Prognosis.

The intensity of the disease varies, and can be estimated to a great extent by the degree of pain.

The results depend to a great extent on the severity of the attack, also on the stage when proper treatment is commenced, and on the formation of the hoof, and character of the complications. Heavy-bodied horses are affected more severely than lighter animals, and there is more hope of recovery when the front feet only are affected than when all four feet are implicated. Once "dropped sole" has occurred the animal ceases to be useful for work on hard rough surfaces. An acute attack of the disease which does not completely recover will result in chronic laminitis.

The hoof becomes more or less deformed, much increased in length and flattened. The wall bulges at the toes; the sole is then flat or convex (dropped sole), and the surface of the wall is marked by irregular rings. The horn becomes dry, brittle, and porous.

Treatment.

Whenever possible the services of a qualified veterinary surgeon should be obtained, as it is very important that proper treatment should be carried out as soon as possible so as to prevent the disease becoming chronic, with its consequent deformities, such as dropped sole, &c. To ensure free movement of the bowels a dose of raw linseed oil, from 1 pint to 1½ pints, according to the size of the animal, may be given by the mouth.

A veterinary surgeon would be able to obtain free movement of the bowels much more quickly by means of hypodermic injections than by giving medicine by the mouth.

The shoes should be removed and the patient stood up to the fetlocks in cold water with a soft muddy bottom. Running water is preferable. Two or three times a day the horse should be taken out of the water and exercised for at least fifteen minutes, as exercise is very beneficial. If it is not possible to keep the horse standing in water, the feet should be placed in cold packs, and the packs frequently moistened with cold water.

The patient should be fed on light rations, preferably green stuff or mashes. Two or three ounces of Epsom salts should be given twice a day dissolved in the water used for making the mash.

If after an attack of laminitis the sole is still concave, an ordinary shoe may be used. When the sole is flattened or convex a seated bar-shoe is necessary.

As a preventative, all stable-fed horses not in active work, should be exercised daily and their grain ration reduced. Overwork and over-feeding with highly nitrogenous foods should be avoided.

PASTURE TOP-DRESSING TESTS.

WESTERN DISTRICT.

(*a*) Cavendish.

The Cavendish plots were established three years ago on a light buckshot loam on the farm of Mr. H. R. Dunster. Prior to top-dressing the pasture was thin and the carrying capacity was low. Where superphosphate has been applied, however, there has been a very considerable increase in growth. In order to obtain an approximate measure of that increase the herbage on three plots, each 1 acre in area, has been cut annually and weighed as grass hay. The results for last year and the average of the three years to date are shown in the following table:—

	Yields of Grass Hay in cwt. per acre.	
	1929.	Average 3 years.
No manure	2·4	1·9
Super. 1 cwt.	10·9	6·0
Super. 2 cwt.	19·1	11·8

The differences in growth were very marked during the season. The unmanured plot was very thinly grassed, with many bare patches, and consisted mainly of isolated tussocks of wallaby grass with little or no trefoil. On the other hand, those plots to which superphosphate had been applied carried a dense sole of grass with a considerable proportion of trefoil and subterranean clover. The encouragement of trefoils and clovers is one of the important effects of superphosphate, and its influence in this direction is indicated by the results of a botanical analysis of the produce cut from these plots. This shows that where no manure was added practically no clovers were present, while the herbage from the plot treated with super. at the rate of 1 cwt. per acre contained 42 per cent. of trefoils. Where 2 cwt. per acre of super. was used the plot was a mass of trefoils, and the botanical analysis disclosed no less than 76 per cent., principally knotted clover.

In addition to these bulk areas there are a number of smaller demonstration plots on which various fertilizers, singly and in combination, are being tried. Yields obtained on these plots last year were as follow:—

	cwt. per acre.
No manure	1·5
Super. 1 cwt.	13·1
Super. 1 cwt. (harrowed)	8·7
Super. 2 cwt.	23·1
Super. 2 cwt. (harrowed)	14·3
Basic Phosphate 1 cwt.	10·2
Super. 2 cwt., and Lime 20 cwt. (1927 only)	16·8
Super. 2 cwt., and Ammonium Sulphate 44 lb.	14·6
Super. 2 cwt., Ammonium Sulphate 44 lb., Potash Sulphate 56 lb.	16·9
Ammonium Sulphate 88 lb.	2·0

These figures indicate clearly that superphosphate is the fertilizer that produced the most profitable increase in the growth of the pasture at Cavendish.

Satisfactory results have attended the sowing-down with subterranean clover of a small area adjoining the demonstration plots. The seed was put on at the rate of 3 lb. per acre with 1 cwt. of super. in 1927. The area was top-dressed with super. at the same rate in 1928, and last year it was given a further top-dressing and harrowed. The clover is now well established, and is filling up the spaces between the tussocks.

(*b*) Warncoort.

The plots at Warncoort were established five years ago by the Department of Agriculture on the farm of Mr. W. J. Dennis, a few miles from Colac, on natural pastures growing on light sandy loam. The yields have demonstrated clearly that the application of from 1 to 2 cwt. of superphosphate per acre to pastures there results in a substantially increased growth and improvement in the quality of the herbage.

Apart from the increased growth obtained, the most important feature of the results was the demonstration of the fact that the effect of the top-dressing persists for a number of years. The tests comprise a series of small demonstration plots treated with various combinations of fertilizers, including super., super. and lime, super. and nitrogen, and a complete manure, and three bulk plots, each 1 acre in area, on which dressings of super. at the rate of 1 cwt. and 2 cwt. per acre respectively are compared with an unmanured plot. On these latter plots the super. was applied in 1925 and 1926 only, and the tests over the last three years have been to determine the residual effect of those dressings. In 1927 the plots were grazed, but in the following year they were cut, and the weight of dry grass hay obtained. From the unmanured plot the yield was 12.5 cwt. per acre, but, where 1 cwt. of super. had been applied two years previously, the yield was 21.5 cwt., and from the 2 cwt. super. plot 29.4 cwt. of grass hay was cut. Last year the plots were again cut and, although no further quantities of fertilizer had been applied, striking differences were apparent in the yields. Thus the unmanured plot yielded 4 cwt. of grass hay, the 1 cwt. super. plot gave 11.3 cwt. and the 2 cwt. super. plot 23.4 cwt.

In the years in which the fertilizer was actually applied there was, apart from the increased growth, a very substantial improvement in the quantity of herbage on the top-dressed plots. A botanical analysis of the pastures showed a big increase in the percentage of clovers, principally subterranean clover, on the areas to which super. has been applied, and a decrease in the percentage of weeds. In the following years, however, the difference was less marked, although last year no clovers were apparent in the unmanured plot, while those which had been treated with 1 cwt. and 2 cwt. of super. per acre contained 3 per cent. and 5 per cent. respectively.

On the smaller demonstration plots increased yields were obtained where additions of lime, ammonium sulphate, and ammonium sulphate and potash respectively, were made with the superphosphate, but the

portion of the increase attributable to them was less than half that due to superphosphate by itself.

The actual yields from the bulk plots are as follow:—

SUPER. APPLIED JULY, 1925, AND MAY, 1926.

Weight of Dry Grass Hay in cwt./ac.

—	1926.	Residual Effect—		
		1927.	1928.	1929.
No manure	3·8	Plots grazed.	12·5	4·0
Super. 1 cwt. per acre ..	16·1		21·5	11·3
Super. 2 cwt. per acre ..	23·6		29·4	23·4

DEMONSTRATION PLOTS.

Yields in cwt./ac. of Dry Grass Hay, actually harvested.

—	Average 1928 and 1929.
Super. 2 cwt. 1925–6–8	29.8
Super. 1 cwt. 1925–6–8	28.9
No manure	11.7
Basic Slag 2 cwt. 1925–6–8	29.3
Super. 2 cwt. 1925–6–8, and Lime 20 cwt. 1925	37.1
Super. 2 cwt. 1925–6–8 .. .. Ammonium Sulphate 44 lb. 1925–6–8	36.3
Super. 2 cwt. 1925–6–8 .. .. Ammonium Sulphate 44 lb., and Potash Sulphate 56 lb. 1925–6–8 ..	38.2
No manure	9.0
Ammonium Sulphate 88 lb. 1925–6–8	9.6
Nitrate of Soda 1 cwt. 1925–6–8	8.2

KORUMBURRA.

Established four years ago on grass land which had deteriorated because of long grazing, the top-dressing experiments conducted by the Department of Agriculture at Korumburra have yielded interesting data as to the effect of super. in regenerating such a pasture. The plots are located on the farm of Messrs. M. C. Lindsay and Sons on land which is typical of the better class hill country of Gippsland.

On this area, however, native grasses and weeds had largely taken the place of the original plants sown, such as cocksfoot, rye grass, and clover, and the experiments were designed primarily to ascertain whether the pasture could be brought back to its original productive state.

The experimental field comprises two sections, one of which is devoted to three bulk plots each 1 acre in area on which dressings of superphosphate at the rate of 1 cwt. and 2 cwt. per acre respectively are being compared with an unmanured check plot. On these plots the produce is cut and weighed as grass hay as an approximate measure of carrying capacity. The balance of the field consists of a number of smaller demonstration plots to which has been applied a

range of fertilizers, including nitrogen potash and the soil amendment lime.

Although the results on the bulk plots have not been so striking as those recorded at other centres, there has been an appreciable increase in the growth of the herbage on those plots to which super. was applied. Thus last year the unmanured plot yielded 17.2 cwt. of grass hay per acre, while that treated with super. at the rate of 1 cwt. per acre gave a return of 23.3 cwt. Where 2 cwt. of super. per annum was applied the yield was still further increased to 26.3 cwt.

The actual yields from the bulk plots for the four years of the test are shown in the following table:—

(Note.—Plots top-dressed July, 1926, June, 1928, and May, 1929.)

Yield of Dry Meadow Hay in cwt. per acre.

Treatment.	1926.	1927. (Residual Effect.)	1928.	1929.
No manure	14·3	11·2	14·1	17·2
Super. 1 cwt. per acre ..	15·6	11·6	17·0	23·3
Super. 2 cwt. per acre ..	19·5	15·6	21.4	26·3

Apart from the effect in increasing growth the superphosphate has had a beneficial influence on the quality of pasture. A botanical analysis of the produce and from the plots shows that where 1 cwt. of super. per annum was added the percentage of clovers was practically double that on the unmanured plot, while where the 2 cwt. dressing was used the percentage of clovers was more than three times that of the untreated area. Similarly there has been a substantial reduction in the percentage of weeds on the top-dressed plots.

On the smaller demonstration plots the maximum yield was given where 2 cwt. of super. and 20 cwt. of lime per acre was applied, but the difference over the yield of the plot which received 2 cwt. of super. alone was not sufficient to justify the commercial use of lime.

Where nitrogenous fertilizers were used with super. no further increases in yield were obtained, and the tests so far indicate that superphosphate is the most profitable fertilizer for use under conditions such as those obtaining on this area.

Yields from the demonstration plots last year were as follow:—

Treatment.	Yield of Meadow Hay per acre.
	cwt.
No manure	16.6
Super. 1 cwt. per acre	37.5
Super. 2 cwt. per acre	42.6
Super. 2 cwt., and Ammonium Sulphate 44 lb. and Potash Sulphate 56 lb.	39.2
Super. 2 cwt., and Ammonium Sulphate 44 lb.	40.0
Super. 2 cwt., and Lime 20 cwt. (1926 only)..	45.7
Basic Slag 2 cwt.	38.9
Super. 2 cwt. (applied in Spring)	40.3
Nitrate of Soda 1 cwt. per acre	19.5
Ammonium Sulphate 88 lb. per acre	21.4

MOOROODUC.

Valuable data as to the effect of superphosphate on pastures on portions of the Mornington Peninsula has been obtained from experiments conducted by the Department of Agriculture at Mooroodue. These plots, which were established two years ago, are being worked in conjunction with the Mooroodue Progress Association by Mr. H. B. Slaney.

The tests are being carried out on a light-grey loam, typical of a large area of country in the vicinity of Mornington, and prior to top-dressing the experimental field carried a sole of native grasses and weeds; now subterranean clover is rapidly establishing itself. In the first year the fertilizer was applied late, but despite that fact there was a substantial increase in the growth on the manured plots. Last year the difference was even more marked, the yield of grass hay from the unmanured plot being 4.2 cwt. per acre, while where 1 cwt. of super. per acre was applied the yield was increased to 12.2 cwt. With a dressing of 2 cwt. of super. per acre the yield was still further increased to 23.7 cwt. The yields of these plots, which are each 1 acre in area, are shown in the following table:—

Treatment.	Yield of Grass Hay per acre.		
	1928.	1929.	Average 2 years.
	cwt.	cwt.	cwt.
No manure	2·5	4·2	3·3
Super. 1 cwt.	5·0	12·2	8·6
Super. 2 cwt.	6·9	23·7	15·3

These figures indicate that there has been a very marked increase in carrying capacity of the pasture where superphosphate was applied. Apart from the increased quantity of herbage produced there has been a considerable improvement also in the quality of the pasture, as evidenced by the percentage of clovers, particularly subterranean clover. Thus, a botanical analysis of the produce cut from the plots last year shows that on the unmanured portion no clovers were apparent, but where super. had been applied the produce contained up to 37 per cent. of clovers, with consequent higher feeding value.

In addition to the bulk tests, the experiments include a number of smaller demonstration plots on which numerous fertilizers, singly and in combination, are being compared. The yields of these plots were as follow:—

Treatment.	Yield.
	cwt. per acre.
No manure	5·0
Super. 1 cwt.	10·9
Super. 2 cwt.	14·7
Super. 1 cwt., and Lime 20 cwt.	11·8
Lime 20 cwt.	10·9
Super. 1 cwt., and Ammonium Sulphate 48 lb.	13·4
Ammonium Sulphate 48 lb.	5·0

THE PIG INDUSTRY.

(Continued from page 358.)

By A. J. Gill, Senior Herd Tester.

The Balanced Ration.

The rations in which pollard and barley should be mixed are as follow:—

	Pollard. lb.	Barley. lb.
At weaning time (i.e., at 8 weeks old)	60 ..	40
At 12 weeks	50 ..	50
At 16 weeks	40 ..	60

Where a mixture of oats and barley is being fed, allow 30 lb. of oats for each 70 lb. of barley.

For barley and wheat the ratio should be—barley 60 lb., wheat 40 lb.

Of course, the prices of the different grains must be taken into consideration, and the cheapest food made the foundation.

When the ration consists of grain and skim milk, it is best to feed the gristed grain dry, through an automatic feeder. The milk should be fed twice daily; a gallon per pig per day is considered sufficient, provided, of course, the animal has access to drinking water. If, however, there is plenty of skim milk on hand, a greater allowance per pig could be made. The advantage of feeding the grain through an automatic feeder is that the pigs will balance their own ration; further, the weaker pigs will be able to obtain an ample share.

Trials have shown that the best results are made when grain is fed in a dry state.

If grain and milk mixed are being fed in the trough, the following proportions will give the best results:—

Age.	Grain or Pollard.	Skim Milk.
	lb.	lb.
At 8 weeks (weaning time)	2½	10
„ 10 „	3	10
„ 12 „	3½	10
„ 14 „	4	10
„ 16 „	4½	10
„ 18 „	5	10

This gives approximately the amounts required to gain the best results. The more food pigs will eat, the quicker they will fatten and the greater profit they will yield. They should at all times where troughs are being used be fed three times daily, and given as much as they will eat in about twenty minutes.

The practice of feeding a pig solely on skim milk is wasteful. Skim milk is a valuable food, rich in protein, and useful to mix with grains to form a balanced ration. Fattened on skim milk alone, a pig may take over seven months to become a "baconer," while if grain

be added to the milk in correct proportion the animal would be fit for the market in five months. A balanced ration not only ensures rapid fattening, but also a better quality of bacon.

Milk fed alone and grain fed alone are not balanced rations. For instance, it will take 5 lb. grain to produce 1 lb. pork; thus, 50 lb. of barley will produce 10 lb. pork. Thirty lb. of skim milk is required for the production of 1 lb. of pork, and 15 gallons for 5 lb. Thus from these two foods fed separately the total quantity of pork produced would be 15 lb., but if they were mixed so as to form a balanced ration the quantity of pork produced would be increased to 18 lb.

When no skim milk is available, meat meal is used to balance the ration and provide the required protein. Meat meal, 10 lb., and linseed meal, 8 lb., added to 100 lb. of any of the cereal-grain mixtures will give a balanced ration for pigs just weaned. As they get older, the quantities of meat and linseed meal may be reduced:—

Age.	Grain.	Meat Meal.	Linseed Meal.
	lb.	lb.	lb.
At weaning time (8 weeks)	100	10	8
„ 10 weeks	100	9	7
„ 12 „	100	8	6
„ 14 „	100	7	5
„ 16 „	100	6	4

After the age of sixteen weeks is attained, the ratio need not be varied. If pigs are on good pasture, they will fatten rapdily. The reason for reducing the quantities of meat and linseed meals is this:—As the pig gets older he requires a broader ration, that is, less protein in proportion to the carbo-hydrates.

When grass is abundant and succulent, the linseed meal may be dispensed with.

When peas are obtainable to mix with cereal grains, less meat meal is required owing to the high protein-content of the peas; for instance, 75 lb. barley, 25 lb. pea meal, 6 lb. meat meal would form a balanced ration. Allowing a pig to balance his own ration is the most economical way of feeding. To do this, two feeders are desirable—a large one, to hold the grain mixture, and a smaller one of two compartments, one compartment to contain meat meal and the other linseed meal. The pig will take just what he requires, and it is very noticeable that when the pasture is young and succulent he will eat very little of the protein-rich foods, but as the grass runs out into stalk he will consume more linseed and meat meal. It is a point worth noting that young leafy grass has double the value for feeding purposes of mature grass. Lucerne, grasses, and clovers all make excellent pasture for pigs. Rape is a valuable crop for grazing. Green barley and oats give good results. Young Japanese millet may also be used. Potatoes are used in some districts for pigs. It is the only pig food that is improved by cooking. Cooked foods generally produce a soft inferior bacon. The boiling of potatoes, however, breaks up the starch granules and makes the food easier to digest. When cooked the water

should be thrown away and the potatoes mixed with grain and skim milk, 1 lb. of grain and 10 lb. of skim milk being allowed for every 4 to 5 lb. of potatoes.

When feeding roots of any description, the pig should be given a gallon of skim milk and 1 lb. of grain daily, and as much of the root crop as he will eat. If no skim milk be available, substitute meat meal at the rate of 4 oz. per pig daily.

The quantities of the various common pig foods required to produce 1 lb. of pork are set out below:—

	lb.
Grain	5
Skim milk	30
Butter milk	30
Whey	60
Slops (waste from restaurants)	20
Potatoes	20
Green lucerne	25

When grain can be purchased at a penny per lb., the fattening of pigs will yield a good profit, and an endeavour should be made to see that grains are so mixed that the average price of any mixture will not exceed a penny per lb. The table hereunder shows the cost of grain per ton at different prices from a farthing to twopence:—

¼d. per lb. = £2 6s. 8d. per ton.
½d. per lb. = £4 13s. 4d. per ton.
¾d. per lb. = £7 0s. 0d. per ton.
1d. per lb. = £9 6s. 8d. per ton.
1½d. per lb. = £14 0s. 0d. per ton.
2d. per lb. = £18 13s. 4d. per ton.

Balanced rations give quicker growth and produce a better quality of pork or bacon. Hereunder are indicated mixtures which are balanced rations:—

From 3 to 3½ lb. grain and 10 lb. skim milk.
10 lb. meat meal and 100 lb. grain.
25 lb. pea meal, 75 lb. cereal grain or pollard, and 6 lb. meat meal.
From 4 to 5 lb. potatoes, 1 lb. grain, and 10 lb. skim milk.

To get the best result from pollard, grain should be mixed with it. If fed alone, it will produce a bacon lacking in firmness. When soaking grains for pigs, do not use more than about 10 lb. of water to every 3 or 4 lb. of grain; an excess amount of water will cause scouring.

Pigs should be Kept in the Open.

The pig is naturally an out-of-doors animal, and should at all times have access to pasture. The keeping of pigs in the open air does away with the need for expensive sties. Movable shelters may be made from old tanks cut in halves, or of a framework of old rails covered with straw, or from waste timber. Only in wet places is a floor necessary. The pigs usually prefer to sleep under the trees, unless it is raining.

The ringlock cyclone fence makes a good pig-proof fence. Pig-netting may be used, with a barbed-wire running along the bottom.

A young pig running on grass usually consumes 1 lb. of grain mixture for every month of its age daily; at 2 months old he will eat 2 lb., at 3 months old 3 lb., and so on. On good pasture a pig should gain 1 lb. in weight for every 3½ lb. of grain mixture consumed. A sow with litter on grass will require 1 lb. of food for each little pig,

and usually a couple of pounds more. For instance, a sow with a litter of ten would require from 12 to 13 lb. of food daily.

Sties should be Roomy and Clean.

If it is not practicable to allow pigs to live out in the open, every effort should be made to see that they are given convenient sties. The walls should be high enough to permit a worker to move about easily in the sty when cleaning it. Further, the sty should be so built that there will be plenty of light and ventilation. Low, dark, and dirty sties are an abomination, and responsible for a large percentage of sickness and deaths. Outbreaks of disease usually commence in such places.

When pigs are kept indoors they should be given greenstuff daily, even if only a small quantity.

The open-air method not only results in greater profits, but does away with the repulsive work of cleaning sties, while the fertility of the soil is increased by the manure. The use of dry feed fed through automatic feeders reduces the labour required, and in this way one man can in a few hours look after a large number of pigs.

Care of Utensils and Troughs.

Utensils and troughs must be kept clean. Casks used for holding skim milk should be emptied and washed out daily. The cause of the death of most young pigs is digestive trouble, which arises mostly from the feeding of putrifying milk or from the feeding of badly-balanced rations. There should be no sudden changes in food. Sour milk must not be fed one day and sweet milk the next.

Mineral Food Essential.

When possible, pigs should be given a liberal supply of charcoal and ashes. This is an easy way to help to supply the mineral matter required. Young leafy grasses and clovers will provide a certain amount of mineral matter, as well as proteins. When charcoal and ashes are not available, add bone flour to the food—allowing 3 lb. to every 100 lb. grain.

Water Supply Necessary.

An ample supply of clean drinking water should always be within easy reach, and the trough should be refilled daily after the pigs have had their mid-day meal.

If pigs have to drink from dirty puddle holes, they may become affected with worms, and it never pays to fatten "wormy" pigs.

Where wallows are used, a little crude oil poured on the water will prevent the pigs drinking the dirty water and help to destroy vermin, or Little's fluid—a non-poisonous sheep dip—may be added, and will have a beneficial effect.

The Ruptured Pig should be Got Rid Of.

Rupture in pigs may sometimes be transmitted by the boar, sometimes by the sow. If this weakness appears in litters of different sows, it is reasonable to assume that it is inherited from the boar, and he should be got rid of. If it is noticed in the litters of any particular sow only, it is evident that she is unsuitable for breeding purposes, and she should be fattened.

Why Bacon is not a More Popular Food in Australia.

The consumption of pork and bacon per head in Australia is only 11.5 lb. per annum. In Canada it is 87.7 lb.; in Britain, 41.8 lb.; and in New Zealand 28.3 lb.

This seems to indicate very clearly that our people have not been supplied with the type and quality of pork and bacon they desire. The breeder may fancy a particular type of pig and advance several arguments to prove it is the best. The butcher may favour another type; the bacon factory manager another; but the point that matters most is what type does the consumer want? It is his taste that has to be catered for, and the fact that Australians buy only 11 lb. of bacon and pork per head yearly indicates that our pig-farmers have not been successful in meeting their requirements. Unless they are prepared to study the requirements of the public, and make every effort to supply them, the industry will not make much progress.

Eighty per cent. of the pork one sees displayed in our shops is too fat. A number of people think that a different type of pig is required for production of pork from the one fattened for bacon. This is really not so; the best type of pig to kill for pork is likewise the best type for bacon.

The public taste has changed during the past 50 years. The demand to-day is for a lean, tender, juicy bacon and pork. This necessitates a fast-growing pig that can be marketed while young, and whose flesh is fine and firm.

(*To be continued.*)

AUSTRALIAN RAIN-FOREST TREES.

A manual designed to provide a simple botanical description of the trees to be found in the sub-tropical rain forests of Eastern Australia, and to record the characteristics which will be an aid to their identification in the field, has been issued by the Council for Scientific and Industrial Research. The descriptions are all original, and it has been the author's intentional endeavour to avoid as far as possible the use of technical terms which are so often unintelligible to the average reader. The field characteristics receive special attention as identification marks.

The volume contains detailed botanical descriptions of over 100 tree species, together with more condensed descriptions of the less important species. Excellent plates to illustrate the general habit of the main species, and enlarged photographs of the leaves, flowers, and fruit, are an outstanding feature of the work.

Accompanying each descriptive note is a bibliographical reference so that any one desirous of furthering his knowledge of any particular species may know where to turn.

The book makes interesting and instructive reading, and should appeal to a wide circle of readers. The writer is Mr. W. D. Francis, Assistant Botanist, Department of Agriculture and Stock, Brisbane. The price of the book is 10s. (posted 10s. 5d.).

CODLING MOTH CONTROL.

REPORT ON 1929–30 EXPERIMENTS AT HARCOURT.

By R. T. M. Pescott, M.Ag.Sc., Assistant to Entomologist.

The control of the codling moth (*Cydia pomonella*) is still one of particular importance to the fruit-growers of the State. The season that has just passed has been one in which the weather conditions were decidedly abnormal, giving the fruit-grower an impression that the codling infestation was much lighter than usual. However, taken over the whole of the fruit season, the percentage of fruit spoiled by the codling moth has been well up to the average. It is estimated that at Harcourt this year the average loss was in the region of from 15 to 20 per cent.

The experimental block was originally situated on the property of Mr. T. Code, at Harcourt. However, after a perfect flowering period, a frost (recorded as 8 deg. on a thermograph) on the morning of 22nd October, destroyed the whole of the young fruit on the trees in this block. A new site was chosen on the property of Mr. Reg. Eagle, Harcourt, where the trees consisted in the main of mixed varieties approximately 20 years old. A further setback was given to the experiments on 25th November, when a severe hailstorm badly marked the experimental block. The fruit later grew out of this marking to a great extent, and the percentage of loss on a plain sample was very small. It was generally noticed that early varieties of apples showed a very low percentage of codling infection, while those maturing later in the season were badly attacked. This was mainly due to the hot weather occurring late in the season and producing a partial third brood of the codling moths.

An idea of the potential amount of the infection can be realized from the fact that late in the month of January, in ten lures of apple juice placed in the trees, on two consecutive nights 121 and 195 moths were collected respectively. This should dispel any idea that the season just passed was not a serious one for codling moth attack.

The object of the experimental work was to determine a spray programme which would prove more successful than those already in use, at the same time proving economical from the standpoint of cost. All sprays were applied with an ordinary motor spray pump, with spray-gun attachments, at a pressure of about 320 lb. per square inch. Paste arsenate of lead, and casein spreader at the rate of ½ lb. of spreader to 80 gallons of spray, were used throughout the experiments.

Time of Applying Sprays.

The first, or calyx spray, was applied when the petals had fallen from the majority of the blossoms. The timing of the cover sprays was determined by observations—

(*a*) of the presence of codling moths in the orchard;

(*b*) of the number of moths caught in traps, baited with 10 per cent. vinegar solution, which were hung in unsprayed trees in the orchard.

The vinegar solution was found to be equally satisfactory for the second brood moths as for the first.

It was found necessary to apply five cover sprays.

Details of Spray Tests.

(All sprays were applied by motor pump at a pressure of 320 lb. per square inch.)

Spray No.	Material.	Date of Application.
	Block "A."—Control.	
1	Arsenate of lead—5 lb. in 80 gallons of water	1.11.29
2	" " " " "	11.11.29
3	" " " " "	27.11.29
4	" " " " "	19.12.29
5	" " " " "	20.1.30
6	" " " " "	15.2.30
	Block "B."—Lead Followed by Oil.	
1	Arsenate of lead—5 lb. in 80 gallons of water	1.11.29
2	" " " " "	11.11.29
3	*White oil A—1 in 40	27.11.29
4	" "	19.11.29
5	" "	20.1.30
6	" "	15.2.30
	Block "C."—Lead Followed by Oil.	
1	Arsenate of lead—5 lb. in 80 gallons of water	1.11.29
2	" " " " "	11.11.29
3	*White oil B—1 in 40	27.11.29
4	" "	19.12.29
5	" "	20.1.30
6	" "	15.2.30
	Block "D."—Lead and Oil Alternately.	
1	Arsenate of lead—5 lb. in 80 gallons of water	1.11.29
2	" " " " "	11.11.29
3	*White oil A—1 in 40	27.11.29
4	Arsenate of lead—5 lb. in 80 gallons of water	19.12.30
5	*White oil A—1 in 40	20.1.30
6	Arsenate of lead—5 lb. in 80 gallons of water	15.2.30

* White oil A—Volck; White oil B—Alboleum. There are many white oils at present on the market, and these two have been taken as representative of them.

Results of Tests.

In all cases, percentages were computed from actual count of apples on each tree. All windfalls were carefully examined for codling infection, and records were kept of these throughout the year. No distinction was made between apples showing one, two, or more entrances, nor between fruit with entrances and stings, if the latter caused a blemish rendering the fruit unfit for export. All sorting and counting were done

by the writer. The trees were examined on the 8th January, and a count of codling infection made; this would represent infection from the first brood.

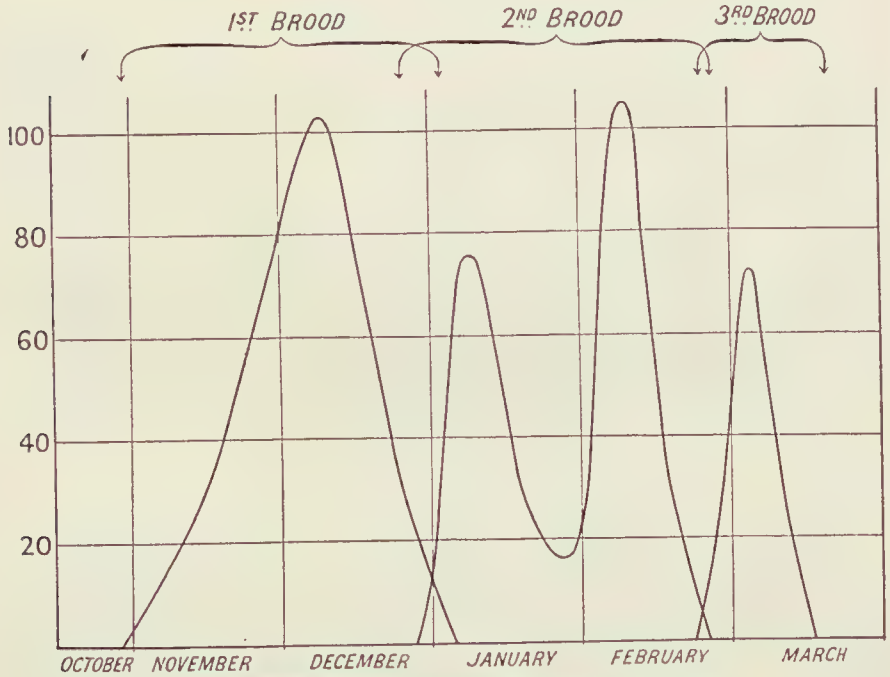
Block.	Material.	Percentage of Codling on 8.1.30.	Percentage of Codling Picking Time.
		per cent.	per cent.
"A"	Arsenate of lead	5·8	17·6
"B"	White oil A	1·3	3·6
"C"	White oil B	3·1	5·5
"D"	Lead and White oil A alternately	1·9	3·8

These results again bear out the conclusions derived from previous experiments, namely:—

(1) Arsenate of lead alone fails to give a satisfactory control.

(2) Arsenate of lead sprays, followed by white oil emulsion sprays at a strength of 1 in 40, again gave a very marked increase in control over other sprays, and, moreover, it was economically sound to use such sprays.

A further interesting result obtained was that in Block "D," where lead and oils were used alternately. The control obtained here was of the same measure as that of the oil sprays alone following lead. This is important, in that the same control is obtained for a reduction in the cost of the spraying materials.



Graph showing number of Moths Trapped in Orchard.

Insects Caught in the Lures.

An accurate weekly record was kept of the number and types of insects caught in the codling lures. The following table sets out in detail the insects captured over the course of the experiment:—

Injurious Insects.

Codling Moth (*Cydia pomonella*)	713
Light-brown Apple Moth (*Tortrix postvittana*)	74
Cut Worms (*Mamestra* sp.)	14
Click Beetles (*Monocrepidus* sp.)	9
Bronze Apple Beetle (*Lagra grandis*)	4
Looper Moths (various genera)	13
Beetles (unidentified)	4

Beneficial Insects.

Lace Wings (*Chrysopa ramburii*)	113
Dragon Flies (*Lestes* sp.)	12
Bees (*Apis mellifera*)	27
Parasitic Flies (*Rutilia* sp., *Syrphus* sp.)	49
Lady Bird (*Leis conformis*)	16

Other beneficial insects included several species of ants, the native Lady Bird (*Rhizobius ventralis*), Clerid Beetles.

Other insects which were present on decaying fruit and caught in the traps were Vinegar Flies (*Drosophila* sp.), and Fungus Flies.

Life History Studies.

First Brood.—No accurate details are available.

Second Brood.—Numerous young larvae were kept under observation, and it was found that the average period that elapsed from the time they entered the fruit until they left it was about sixteen days. The first larvae were found in the bandages on the 26th December, 1929. It was further observed that the period of pupating of these larvae never occupied more than one week.

Many of these pupae were kept under observation, and they were found to remain in the pupal stage for a period of only nine days, a period which is considerably less than that occupied by the pupae of the first brood. This emphasizes the effect of temperature conditions on the development of the codling moth.

Third Brood.—It was found with this brood that the feeding period of the larvae extended over an average of seventeen days, when the larvae left the fruit and entered the bandages. These remain as the over-wintering larvae for the following year.

SUMMARY.

From actual observations in the Harcourt district, where it was estimated that the loss of fruit was in the neighbourhood of 15 per cent., it was evident that the codling moth was as prevalent in the season 1929-30 as in previous years. Reports have shown that in other districts the infestation was not so severe as usual, which fact might be accounted for in the abnormal season experienced.

The results of the experimental work showed that satisfactory control could not be obtained by the use of lead arsenate alone. This confirms the results of previous experiments carried out at Harcourt in the years 1926-29. Satisfactory control was, however, obtained where a white oil emulsion was used as an ovicidal spray after the preliminary arsenical calyx sprays. This also bears out the results of previous work; a summary for the three seasons 1927-30 is as follows:—

Arsenate of lead sprays alone, 30 per cent. codling.

Arsenate of lead calyx sprays followed by white oil, 9 per cent. codling.

The results of Block D, in which arsenate of lead sprays and white oil sprays were used alternately, look promising, but at the present cannot be recommended.

The following spray programme, based on the results of three years' experiments, can be recommended:—

Two sprays of arsenate of lead (5 lb. of paste lead in 80 gallons of water) as calyx sprays applied at intervals of ten days, followed by three or four sprays (depending on weather conditions) of a white oil emulsion (1 in 40) at intervals of approximately one month. The timing of these latter sprays should be accurately determined by the orchardist himself by the use of lures placed in the trees in his orchard.

ROSE DISEASES AND THEIR CONTROL.

(Continued from page 396.)

(*By B. J. Grieve, M.Sc. (National Rose Society's Research Scholar; Fred Knight and Wyselaskie Scholar.*)

III.—CROWN GALL OF ROSES.

For many years, Crown Galls have been observed on various kinds of plants, including cultivated roses; indeed, references to such galls on plants in Europe go back over a period of 90 years. It was not till comparatively recent times, however, that the real cause of the formation of these galls was successfully demonstrated.

The galls were usually ascribed to frosts and mechanical injuries. Sorauer[9] considered galls occurring on rose stems to be primarily due to frost, while Güssow[4] considered similar cankerous galls to be due to a fungus known as *Coniothyrium Fuckelii* Sacc. We are not sure in this case, however, whether Güssow[4] was dealing with a true crown gall or with Common or Stem Canker of rose, which is caused by *Coniothyrium Fuckelii* Sacc. G. Massee[5], in the supplement of his book on *Diseases of Cultivated Plants and Trees,* says:—"Rose Canker, described as being caused by *Coniothyrium Fuckelii* Sacc., has been proved to be a bacterial disease, due to the same organism as that causing Crown Gall. The Coniothyrium is a secondary agent only." It is impossible now to say whether the "Rose Canker" of Güssow and Massee was really Crown Gall.

In 1903, Scalia[6] described a tuberculous disease of roses in Catalonia. He isolated a number of organisms, one of which seemed to be constant in occurrence and character. He gave this organism the provisional name of *Bacillus rosarum,* promising further papers. No further publications on this subject by him have appeared. Smith and Townsend[7], in America, who later isolated the causal organism of Crown Galls, consider the name *Bacillus rosarum* to be a *nomen nudum.*

References to Crown Gall were made about 1892 in the United States of America, but the disease was probably present long before this. Smith and Townsend[7], in 1907, showed the disease to be due to a bacterium, to which they gave the name *Bacterium tumefaciens* Sm. & T.

References to Crown Gall were made in Australia in 1920[1], when it was found badly affecting apple and pear trees in New South Wales. It has since been recorded for Victoria, Queensland, and Tasmania, and is no doubt present in the other States as well. Owing to its wide host range, the fact that Crown Gall disease is in a country allows one to predict that it will be found sooner or later occurring on rose bushes. Crown Galls have been recorded as occurring on roses at Sutherland, in New South Wales (1927); at Brisbane, in Queensland (1926 and 1928); and rose-growers in Victoria say they have occasionally found Galls occurring on roses.

Economic Importance.

The disease appears to be prevalent on roots of roses grown in hot-houses in the United States of America, in England, and on the Continent. Skilled gardeners believe that the galls are very injurious, since they reduce the size of the plants, the amount of foliage, and the vigour of the flowers. No comparative studies appear to have been made to determine the extent of the damage caused by the disease and the varieties affected, but the toll must be heavy, since the energy used up by the plant in producing galls is considerable. Thus one expects an inferior class, or fewer number, of blossoms. From information obtained by Smith and Townsend[7], there is evidence that the disease may be very serious, e.g., one rose-grower had every plant out of 10,000 plants in a green-house affected. Between 200 to 300 died. He expected to obtain 1,500 to 2,200 buds a day, but obtained only 400 to 600 a day, representing an average loss of 67 per cent. of his season's blooms. In this connexion, it might be mentioned that Manetti stocks are reputed to be very susceptible to the disease.

In Australia, where little glass-house rose-growing is carried on, the same conditions are not reproduced, and from an economic point of view, little damage is done by Crown Gall on roses.

Symptoms.

The symptoms characteristic of Crown Gall are the production of gall-like protuberances around the crown or base of the plant, or even high up on the stem. The ultimate effect of these galls, which may be small or comparatively large on rapidly-growing plants, is to produce a stunting of growth of the plant. The galls are formed by the abnormal multiplication of plant cells under the stimulus of the bacteria. Crown Gall has been aptly termed "plant cancer," because it resembles in many respects the condition of cancer in animals.

Etiology.

Crown Gall of roses is caused by *Bacterium tumefaciens* Sm. & T. As indicated earlier, the greater number of European observers assigned the cause to physical agencies, e.g., late frosts and winter kill. Others thought that insects were responsible, while some considered the cause to be bacterial or fungal, but pathogenicity was not established. In 1907, Smith and Townsend[7] described a plant tumour of bacterial origin having proved pathogenicity by inoculating successfully tomato, tobacco, and castor oil plants with an organism isolated from a gall on Paris daisy. In 1908, Townsend[10] reported experiments in which he showed

Fig. 6.—Crown Gall on Roses grown under Glass. (After Heald.)

that an organism isolated from galls on roses, and which appeared to be identical with that isolated from Paris daisy, was cross-inoculable onto other hosts. These results were confirmed at a later date by experiments carried out by Smith, Townsend, and Brown[8]. They found, however, that roses were fairly hard to infect artificially; out of thirty (30) inoculations, only in four (4) instances was the disease reproduced. This is rather remarkable, in view of the great losses which are sustained in rose green-houses in America.

Morphology of the Organism.

The Crown Gall organism isolated from a new rose was a gram negative, polar flagellate bacterium of a size varying from .5 to .6μ in diameter, and from 1 to 2.5μ in length.

Control.

The main means of spread of the disease is by infected nursery stock; and, therefore, growers should carefully inspect any new plants they buy for signs of galls. Infection takes place only through wounds, and for this reason newly-budded plants should be carefully wrapped and protected from injury until the union heals properly.

N. A. Brown[3], in 1923, carried out breeding experiments with rose seedlings to try to produce roses immune to the disease. According to her, a seedling was produced which appeared quite resistant, but in two years this resistance had appreciably lessened. If this be the case, it is doubtful whether much success will attend experimenting in this direction; but the success which has attended the work of various plant pathologists in breeding plants immune to various diseases allows us to hope that some solution of this problem may be given in the future.

The science of bacteriophagy in relation to bacterial plant pathogens, at present in its infancy, may prove of value in combating Crown Gall, although recent experiments have so far been unsuccessful.

We must admit, however, that there is at present no cure for the disease once it enters a plant—the plant must be dug up and destroyed. No fresh rose plants should be planted in the infected soil for at least two years, since the bacterium can live saprophytically in the soil for that length of time, and still be able to infect new plants.

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IV.—COMMON OR STEM CANKER.

Cankerous diseases of roses represent a distinct class of disease which mainly affect the stem. It is often hard to tell which cankerous disease one is dealing with, without isolating the causal organism, and growing it in pure culture, since to some extent the lesions produced resemble one another. The disease to be described under the above heading has been known for many years, but was specifically described in Germany and in Great Britain only in 1908-1909. It is reputed to affect nearly all varieties of outdoor roses, but definite information on this point appears to be lacking.

History and Distribution.

The fungus responsible for Common or Stem Canker of roses may occur on other hosts than the rose. Saccardo[7], in 1884, records the presence of the disease on *Rubus, Rosa,* and *Tecoma,* in Italy, France, Germany, and Austria. Sorauer[10] described the disease in Germany in 1908, and Güssow[3] described it in Ireland in 1909, when he found it occurring in Hybrid Tea and Wichuraiana roses. P. O'Gara[6], an American worker, showed, in 1911, that *Coniothyrium Fuckelii* Sacc. was parasitic on and cross-inoculable from apple trees to rose bushes. Common Canker of roses was recorded for Australia in 1914; New South Wales, Sydney and suburbs. A condition resembling Common Canker of rose has recently been observed in Victoria.

Some confusion existed in the minds of workers as to whether *Coniothyrium Fuckelii* Sacc. was really responsible for stem cankers, after Smith and Townsend[9] had proved that Crown Galls on plants were due to *Bacterium tumefaciens* Sm. & T. Thus Massee[5], in 1915, wrote, "Rose Canker, described as being caused by *Coniothyrium Fuckelii* Sacc., has been proved to be a bacterial disease due to the same organism as that causing Crown Gall. The Coniothyrium is a secondary agent only." It is, of course, impossible now to say whether Massee[5] was right in his assumption, but since *Coniothyrium Fuckelii* Sacc. is undoubtedly parasitic, producing a cankerous condition in roses, we may be sure that some of the cankers observed were primarily due to this fungus. Bewley[1], in 1923, describes Common Canker on hot-house roses in England, and speaks of the formation of a definite raised cankerous condition.

Fig. 7.—Common Canker of Rose. (After Jenkins, *Amer. Rose Ann.*, 1927).

Symptoms.

The disease commences in one-year-old wood, and its presence is revealed by small pale-yellow or reddish spots scattered over the green bark. These gradually increase in size, and several spots may grow together, resulting in a large infected area. The wood tissue in these areas becomes dried and the bark cracked, so that a canker is formed.

The canker may increase in size until it surrounds the stem, when the part above the canker wilts and dies. The cankered areas are depressed, with raised margins, and this is one means of distinguishing it from other cankerous diseases. Later, cracks develop at the infected points and increase in size, becoming extended and distorted by the production of callus, until a typical canker is produced. Fruiting bodies are developed in the cankered areas.

Etiology.

Common or Stem Canker of roses is caused by the fungus *Coniothyrium Fuckelii* Sacc., this being the conidial stage of *Leptosphaeria, coniothyrium* (Fkl.) Sacc.

The conidial or Coniothyrium stage is the one found on diseased plants, but Stewart[11], in 1910, proved its relationship to *Leptosphaeria* by pure culture studies. Godfrey[2], in 1917, also proved their relationship. O'Gara[6], in 1911, showed that *Coniothyrium Fuckelii* Sacc. was pathogenic to roses; but Vogel[12], in 1919, stated that *Coniothyrium*

Fig. 8.—Common Canker of Rose. (After Massee.)

Fuckelii Sacc., when isolated from black raspberry canes, would not infect rose shoots. This suggests a possibility of there being different strains of the fungus, Waterman[13] in a recent paper shows that *Coniothyrium Fuckelii* Sacc., when isolated from a diseased rose, is pathogenic to healthy roses. She has concluded, also, after detailed morphological, cultural, and physiological studies of *Coniothyrium Fuckelii* Sacc., and *Coniothyrium Rosarum* Cke. & Hk., isolated from rose plants affected with Common and Graft Canker respectively, that these two fungi are identical, and that therefore *Coniothyrium Fuckelii* Sacc. is also responsible for Rose Graft Canker. Vogel[12] had previously described Rose

Graft Canker as being due to *Coniothyrium Rosarum* Cke. & Hk. For the purposes of this survey, Rose Graft Canker will be treated separately.

Morphology.

Coniothyrium Fuckelii Sacc.

Pycnidia superficial, scattered, dark, 180-200μ, globose, depressed; conidia numerous, elliptical, unicellular, brownish, 2.5 – 5 × 2 – 3.5μ.

Leptosphaeria Coniothyrium Fkl. Sacc.

Perithecia gregarious, spherical, black, with an erumpent ostiole asci cylindrical, 8 spored; ascospores uniseriate, oblong, three septate, brownish, 10 – 15 × 3 – 4μ.

The Coniothyrium stage is the stage associated with Common Canker of the rose, but Martin[4], in a recent paper, has shown that there is another stage of this fungus which is actively parasitic on the rose. He has obtained a yeast-like fungus from cankers on rose stems, hips, and from spots on the leaves, which on cultivation proved to be the initial phase of *Leptosphaeria Coniothyrium* (Fkl.) Sacc. This fungus had previously been reported under the names *Polyspora sp.* and *Kabatiella* sp. Martin[4] has designated this stage of the organism as *Pseudo-saccharomyces.* A *Pseudo-fumago* stage has been obtained by the budding of *Pseudo-saccharomyces.* Martin[4] considers that *Leptosphaeria Coniothyrium* (Fkl.) Sacc. is a polymorphic, facultative organism with several phases in its life history.

Control.

The spraying of roses affected with Common or Stem Canker appears to have no value. Cankered stems should be cut out, and the prunings burnt. The secateurs must be sterilized after each pruning operation, while any abrasions noticeable on the stems should be coated with tar or paint.

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(*To be continued.*)

PRUNE DRYING.

By F. de Castella, Horticultural Division.

Prunes are the dried, or more correctly the partially dried, fruit of certain sorts of plum. The term "prune" is derived from the French, in which language it signifies the fresh fruit of the plum tree, being the exact equivalent of our English word plum. In France, the dried fruit that we know as prunes are termed Pruneaux.*

In English the word is extended in its application to include those plum varieties that are suitable for drying. We thus speak of the Agen prune†, the Italian prune, and so on. It follows that all prunes are plums, but the converse does not hold good, for only a few plum sorts are really suitable for drying into prunes, and therefore deserving of this name.

Few fruits have been so well fitted by nature for preservation by drying as the plum, and only one fruit is more extensively dried, viz., the grape—of the two, nearly twice as many grapes are dried‡. Both these fruits have a high drying ratio. In other words, less fresh fruit is needed to produce 1 lb. of dry, than in the case of apricots, peaches, or pears, for which the drying ratios are in the neighbourhood of 5 to 1, and sometimes a good deal less. The prune, indeed, beats the raisin in this respect. The drying ratio of the latter averages about $3\frac{1}{2}$ to 1, whilst that of the prune is 2 to 1 to 3 to 1, and in exceptional cases even as high as $1\frac{1}{2}$ to 1. The average is about $2\frac{1}{2}$ to 1.

This is not so much due to a high sugar content as to a high proportion of solids other than sugar, and to the fact that the prune is dried without removing the pit, as is usual with most other fruit. Some analyses mentioned by Professor Christie§ show that Californian prunes in the fresh state averaged 19.6 per cent. of sugar, 9 per cent. of solids other than sugar, and 5.1 per cent. of pits. A sugar percentage of 19.6 is equivalent to just on 11 degrees Baume. This is less than is averaged by our drying grapes, but pits and solids, other than sugar, which between them amount to 14.1 per cent., no doubt account for the higher drying ratio.

It is true that some plums are halved and pitted before drying, but these are known to the trade as dried plums. They are not really prunes, which invariably retain the pit.

The prune is an excellent, wholesome, and deservedly popular article of diet, which has forced its way to the front rank amongst household necessities the world over, owing to its agreeable flavour and high food

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* Pronounced "prune-oh."

† Often spelt d'Agen—meaning of Agen the small town that is the centre of the prune district. The name of this town being used in an adjectival sense, there is no need for the preposition "d" before it.

‡ See p. 5, where the world's production of prunes is shown to be in the neighbourhood of 300,000 tons. In 1927 the world production of dried grapes (Report of Development and Migration Commission 1927) was 530,300 long tons (388,050 tons raisins and 142,250 tons currants), or roughly double that of prunes.

§ A. W. Christie, "The Dehydration of Prunes." University of California Bulletin, No. 404, August, 1926, p. 10.

value. Though usually stewed and served as a compote, with or without cream and rice, the better grades are acceptable in the raw state as dessert. The prune has also a distinct medicinal value, owing to its mild laxative properties, that gives it a place in the *materia medica.* In France, medicinal prunes are dried from special plum sorts, as is described below.

A good prune has a thin, black or purplish-brown, coarsely-wrinkled skin, slightly moist to the touch, but not wet and sticky. The pulp should be abundant, soft, and pliable, and not hard and leathery. It should separate readily from the pit, and be of a rich brown colour, though in most American types it is amber yellow.* It is mucilaginous, and sweetly acidulous, with a flavour altogether its own, quite distinct from any other dried fruit, and which does not recall that of the plum from which it was dried. In this respect, the prune is very different from the dried peach or apricot, which, after cooking, much more resembles the stewed fresh fruit. This peculiar and characteristic "prune taste," rather suggestive of liquorice, and vaguely of plug tobacco, and perhaps also of the Chinese *Li Chi,* develops during the drying process, especially when artificial heat is used. It is most pronounced in the choicer grades, and is less noticeable, and sometimes lacking altogether in the lower grades.

Unlike several other fruits extensively dried, the prune is not sulphured. It is true some dried plums are so treated, including the so-called silver prunes, and also golden prunes. Sulphuring would radically alter the character of the product, reducing the dark colour of the skin that is so essential, and preventing the development of the true prune flavour.

Size is essential to quality. It is the big prune that fetches a high price, not merely because it is big, but because it shows high quality in other directions. Hence the soundness of the long-established practice of grading according to size—according to the number it takes to weigh 1 lb. 32's are very large choice fruit, whilst 70's are small and ordinary.

Figs. 1 and 2 (pages 504-5) will give an idea how prunes differ according to grade. Fig. 1 shows French "32's" of very high quality. In Fig. 2 several distinct types are compared, reduced to half natural size. Though "*c*" and "*d*" show little apparent difference in size, the former weigh heavier, the pulp is sweeter and softer, with smaller pit. Dehydrated differ much in appearance from sun-dried, the latter being more finely wrinkled, with dull rather harsh surface, unless finished, with a glycerine or syrup dip. The dehydrated prune is coarsely wrinkled, and somewhat flattened with smooth, glossy, or velvety surface that gives it a characteristic and more attractive appearance.

The prunes that are sold in shops vary enormously in type, in quality, and in price. From the best French dessert prune—excellent to eat raw—to the thick-skinned, over-dried, under-sugared apology one too often has the misfortune to meet with, is indeed a wide range. There is, no doubt, a demand for all classes, and perhaps the greatest

* Christie states (loc. cit.) that the flesh should be a light amber colour, yet the flesh of the highest grade French prunes is almost as dark as the skin.

demand is for the cheaper grades; but it is the quality article we must set up as our standard, as the objective, we should use our best endeavour to attain.

Neither as regards quantity nor quality has our prune industry reached the measure of success achieved by our dried grape growers. During the 1927-28 season, the Commonwealth produced 1,179 tons of prunes, as against 55,000 tons of dried grapes in 1926-27; and yet, when it comes to world production, the ratio of dried grapes to prunes is scarcely 2 to 1. Though we produce some excellent prunes, there is far too much fruit of regrettably low grade to be found on the local market. Hence it is that we import so largely of this fruit. For the year 1927-28, our imports (Commonwealth) were 771 tons, or considerably more than half as much as we produced in that year. It is worth noting that the two together only reach a total of 1,932 tons, or less than ¾ lb. per head of population. There would seem to be room for considerable increase in the consumption of this excellent and most wholesome fruit. Statistics show that we are not holding our home market as we should. Our production has, it is true, increased considerably, mainly in New South Wales, but our imports have increased in even greater proportion, in spite of a protective duty of 4½d. per lb.* The consumer is prepared to pay a higher price for the imported article on account of its better quality. We can grow plums equal to anything in the world, and with a little more attention to processing, there is no reason why our prunes should not be at least equal to those we import from overseas. In order to turn out a prune of equal grade, we must obviously apply the methods which permit our overseas rivals to successfully compete in our home market. The best prunes are produced in France. American prunes, though not equal to the French, are of a higher average quality than ours. In the following pages, it is proposed to outline the process usually followed by our prune-growers, as well as the methods prevailing in the United States of America and in France. Prune processing has received much serious study in the United States of America of recent years. Several excellent publications have been issued in that country by State and Federal authorities. The industry has been extended enormously, America being now the leading producing country. The quality of the American product has greatly improved during recent years, though it has not reached the level of the best French prunes, which are still unchallenged for excellence the world over.

It would indeed appear that the discontinuous French method of artificial drying with three successive heatings in the drying chamber, the fruit being withdrawn and allowed to cool between each, is conducive to a higher quality standard than the continuous American tunnel, which the fruit enters at one end in the fresh state, leaving the other end 20 to 36 hours later in a practically dry state.

Our prunes are mainly sun dried. French prunes are, and always have been, dried by artificial heat. The higher temperature of the drying oven seems to be necessary for the proper development of the characteristic prune flavour; without it, this essential feature is either

* This duty was increased on 22nd November, 1929, to 6d. per lb.

partially or wholly absent. In California, de-hydration is steadily taking the place of sun-drying, with a resultant improvement in quality and increased yield per ton of fresh fruit, as is explained below.

Some Prune Statistics.

According to the United States Department of Agriculture,* the prune production of the world in 1926 amounted to nearly 250,000 tons, as follows:—

World Production of Prunes.

(Tons, in round numbers.)

—	1920.	1925.	1926.
	Tons.	Tons.	Tons.
California, United States of America ..	87,750	130,500	132,300
Pacific North-West, United States of America, Oregon &c.	15,750	11,700	33,750
Yugoslavia	59,760	49,500	74,700
France	8,010	990	8,100
Australia	..	744	512
	..	193,434	249,361

These figures must somewhat underestimate the world's production, since no mention is made of such countries as Germany, Hungary, Roumania, Italy, and South Africa, where prunes are dried, though not, perhaps, in very large quantity. Australia has also progressed—her 1928 production being more than double that of 1926. California has also largely increased her production—in 1927, her prune pack amounted to 203,000 tons,† so that the present world production of prunes must be in the neighbourhood of 300,000 tons.

The recent increase in the prune production of the United States has been phenomenal, and a very important export trade from that country has been developed the world over. The figures for the three years to 1928 are as follow:—

Export of Prunes from United States of America.

Year.	Tons.
1925–26	67,375
1926–27	78,117
1927–28	115,977

Owing to severe frosts, the 1928-29 pack was considerably smaller, with a corresponding reduction in export.

Careful grading and packing has enabled America to put on the world's market a prune of uniform, reliable, and satisfactory quality, at a reasonable price, which has found it a ready sale, even in prune-producing countries, such as France, which imported during the years

* Circular 416, U.S.A. Department of Agriculture, by Burke H. Critchfield, Agricultural Economist, Bureau of Agricultural Economics, Washington, D.C., April, 1927. The figures therin stated in lb. have been reduced to long tons, and Australia's production added.

† Compiled by the Dried Fruit Association of California—quoted in News Bulletin of Commonwealth Department of Markets and Transport—30th August, 1928.

1922-26 a yearly average of 10,119 tons of American prunes—in other words, more than France's total production. Hence, the curious situation that, though France is able to cater for the world's trade in prunes of the highest grade, American can compete, even in France itself, with a cheaper article. The bulk of the American prunes imported by France (95 per cent. of them) were Californian.

There is considerable difference between the Californian and the North-western prunes (Oregon and Washington). The latter, usually spoken of in America as the Italian, is mainly dried from the Fellemberg plum, better known in America as the Italian prune. It is distinctly more tart than the Californian, which is mainly dried from the Agen prune. The North-western prune, however, is slightly larger; it finds a demand with a different class of customer, and is popular with foreigners residing in America, both on account of its special flavour and cheaper price.

French prunes are remarkable for quality rather than quantity. The industry is more restricted to-day than it was half a century ago, when France was the world's main supplier. The yield varies much from year to year. It is a "de luxe" product; but since it is the last word in quality, the drying methods followed present great interest, and are considered in detail in a special section of this article.

The decline of the Agen prune industry is mainly due to a rather mysterious dying off of the plum trees that has occurred in most prune orchards in this part of France during the past 30 years; it has recently been attributed to depletion of soil phosphates after many years of prune culture with insufficient phosphatic manuring.*

Yugoslavia now includes Serbia, which has long been celebrated for its plums and prunes. It is second only to California as a prune producer. Its plums were originally grown for the making of *slivovice,*† or plum brandy, which is the most important alcoholic beverage of the Serbs. In that country, prune production, notwithstanding its importance, is even now secondary to distillation. Plantation of plum trees has been considerable since the war, nurseries for the purpose receiving Government support. Harvesting and drying methods, though rather primitive in the past, have been greatly improved recently.

Yugoslavia and Roumania also produce large quantities of *Pekmez,* a sort of unsweetened plum jam. It is estimated that, of the total plum crop in these countries, 40 per cent. is made into Slivovice, and 20 per cent. into Pekmez, leaving 40 per cent. for prune drying and consumption as fresh fruit.‡

According to Critchfield (*loc. cit.*), "Germany is the largest prune-importing country in the world, and is the leading market for prunes from California and Yugoslavia. Germany takes second place, however, as compared with the United Kingdom as a market for prunes from Oregon and Washington, and from France." Californian exports to the United Kingdom have increased considerably of recent years.

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* G. Guittonneau in *Revue de Viticulture,* 23rd January, 1930.
† Sometimes spelt *Slivovitz.*
‡ E. M. Mrak and W. V. Cruess—"Utilization of Surplus Prunes"—University of California Bulletin No. 483, Nov., 1929.

Australian Figures.

The following table gives the prune crop of each State of the Commonwealth during the past three seasons:—

—	1925-26.	1926-27.	1927-28.
Prunes Dried.			
	Tons.	Tons.	Tons.
New South Wales	156	95	641
Victoria	138	141	274
South Australia	210	165	254
Western Australia	3	..	..
Tasmania	4	..	..
Commonwealth	511	401	1,179
Prunes Imported into Australia.			
From United States of America	125	290	747
From other places	17	24	21
	142	314	768
Prunes Exported from Australia.			
	7	2	4

The Plums from which Prunes are Dried.

Several distinct types of prune are met with in commerce, owing their peculiar character to the country and district where grown, to the plum sort from which they are dried, and to the processing to which they were subjected.

Though all plums can be dried, only a limited number of sorts are capable of conversion into what is commercially known as a prune. Victorian nurserymen catalogue the following sorts as prunes:—Agen, Robe de Sergeant, French, Fellemberg (Italian), German, Golden, Giant, Sugar, Silver, and Splendour. There is regrettable confusion in connexion with several of these, particularly the two first-named. In France, the prune grown in the Agen district, where it is called prune d'Ente, and the Robe de Sergeant, are identical. In Australia, and also in California, the names are given to distinct sorts. It would appear that concerning one, or perhaps both of these, a mistake has been made, and some other plum wrongly imported under one of these names. The Agen prune is better known in France as prune d'Ente. It is the one from which the best French prunes are dried. In Australia we have, in addition to the one we grow as prune d'Agen, another somewhat different sort, known as "French prune." In the Goulburn Valley, indeed, there are several variations of the Agen.

In America, similar confusion exists concerning the Agen and Robe de Sergeant, which names are there given to two distinct sorts—the second

having darker green leaves than the first, and a somewhat different fruit. The Californian Agen is better known as French, and also as Petite prune. It is the sort most largely grown in California, though Imperial, Sugar, and Robe de Sergeant are also grown for drying. The last is stated by Christie and Barnard* to be similar to the French.

According to Hendrickson†, the Californian Agen is self-fertile, and Robe de Sergeant is self-sterile, therefore needing interpollination. The second also has a thinner skin, and needs more careful dipping.

In the Pacific North-west (Oregon and Washington), though the Agen is grown to some extent, the most important plum is the Italian, or Fellemberg (sometimes spelt Fallenberg in America), which yields a somewhat larger prune, more tart, and more in demand with a certain class of consumers.

In France, prunes are dried in different parts of the country, the districts that have specialized in this product being Agen, in Lot et Garonne Department; Tours, in Indre et Loire; and Brignoles, in Var. The first is by far the most important. It is the Agen prunes that are known the world over as French prunes, or sometimes as Bordeaux prunes, from the port of shipment. These are dried exclusively from the Agen prune, or, as it is better known in France, the prune d'Ente, a name which in that country is synonymous with Robe de Sergeant. In France, the two are identical. Agen is not the name of a plum, but of a town—the centre of the prune industry. The name prune d'Ente signifies grafting prune (*Enter* means to graft). Possibly in former days a good many seedlings were grown, and the special selection that gave the best commercial product was propagated by grafting.‡

Tours prunes are dried from the Sainte Catherine plum, whilst at Brignoles, a plum known as Perdrigon Violet is mainly grown.

What are known as medicinal prunes are dried from two plums named Petit Damas Noir, and St. Julien. They are less sweet than the Agen prunes, but are esteemed for their laxative properties.

Other plums are held to be suitable for drying in France, such as Quetsche d'Allemagne, and Quetsche d'Italie—this last seems to be identical with the Fellemberg, or Italian prune, so extensively grown in Oregon, United States of America. Mention must also be made of Damas Rouge, Diaprée Rouge, Jaune Tardive, Reine Claude de Bavay, and Tardive Musquée, which are sometimes grown for drying.

The different Stages of Processing.

The processing of the prune, from the ripening of the fruit on the tree to the packing and marketing of the finished article, naturally resolves itself into a series of distinct stages, and though there may be wide variations in different regions, there are certain fundamental principles common to each stage which are general in their application.

By way of introduction, a quotation may be permitted from a French Agricultural classic.§ In addition to its historical interest, it indicates

* The principles and practice of Sun-drying Fruit—University of California Bulletin, No. 388—by A. W. Christie and L. C. Barnard, May, 1925.

† *Prune Growing in California*, by A. H. Hendrickson, Bulletin No. 328, University of California publications—1921.

‡ Curiously enough it is stated in *Le Bon Jardinier*, a standard French horticultural work: that this is the only plum that does better on its own roots (from suckers) than grafted.

§ *Le Livre de la Ferme*, compiled by various authorities under the direction of Pierre Joigneaux. First edition about 1863. A note on prunes is contributed by A. Lesne.

some of the dangers to be guarded against in modern operations on a commercial scale.

The prune industry seems to have its origin in France, where it was gradually industrialized from the home drying of plums in the baker's

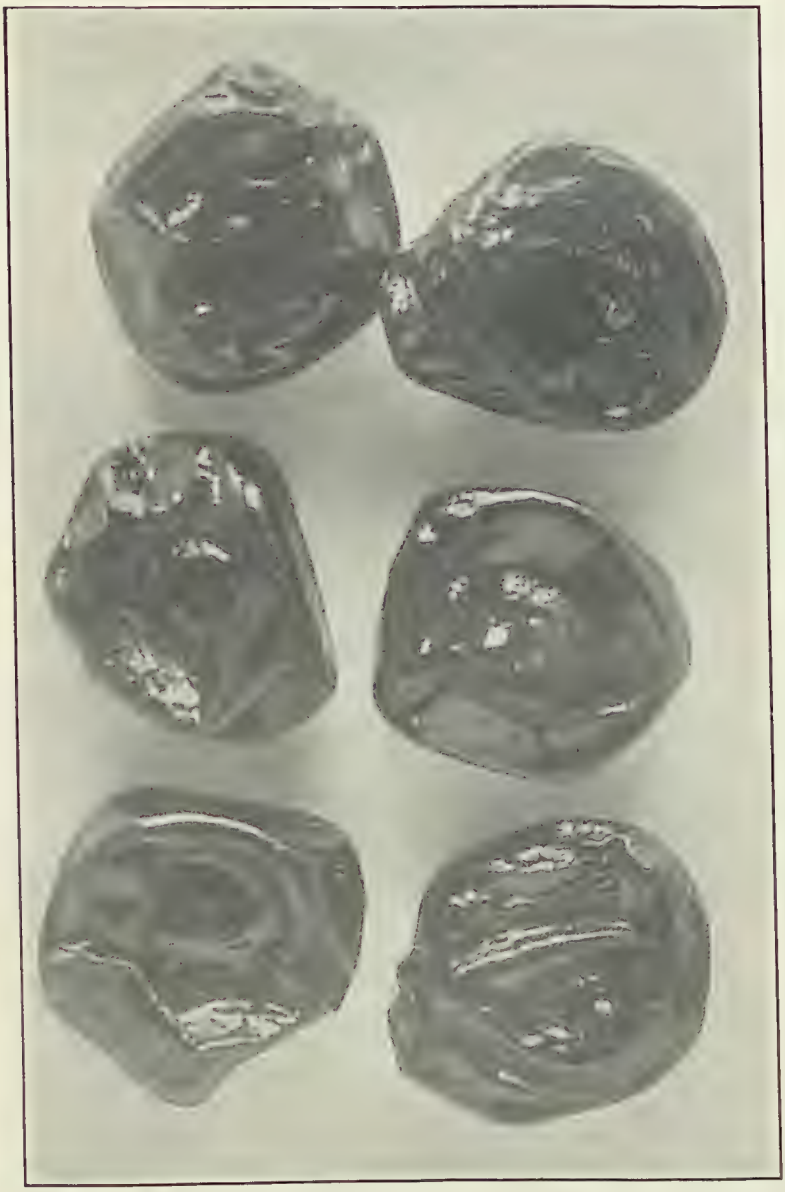

Fig. 1.—High grade French Prunes—"32's," i.e., 32 to the lb. weight.
Like all French prunes these were dehydrated. (Natural size.)

oven after the baking of the bread, a practice several centuries old. In the beginning, prunes for home use were, no doubt, sun-dried in a warm autumn, recourse to the oven being only for finishing, in a bad season. The superiority of artificial drying led to its general adoption, and to the development of the prune industry on a commercial scale.

"Prunes are seldom dried in a satisfactory manner," says M. Lesne. "They are nearly always over-dried. The process should, however, be limited to the removal of excess water of vegetation from the fruit so that it will keep, not in a dry state, but in a soft state—a very different matter."

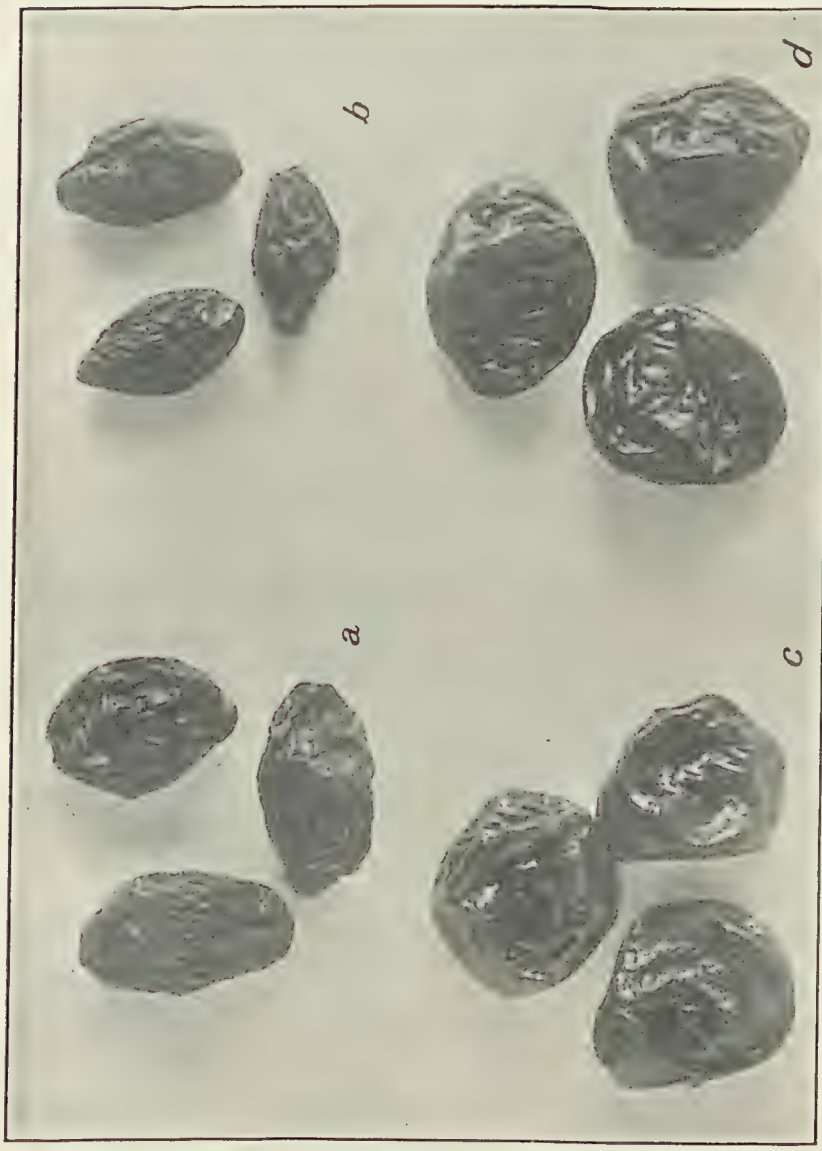

Fig. 2.—Different Prune Types Compared. (One-half natural size.)
(*a*) Australian "60's," sun-dried; (*b*) Australian "90's," sun-dried; (*c*) French "32's," dehydrated (same sample as in Fig. 1); (*d*) Australian "40's," dehydrated. Note difference in appearance between sun-dried and dehydrated.

"Take the plums when altogether ripe, when they fall of their own accord, or on slight shaking, spread them on trays, and place them in an oven after the baking of the bread. The essential point, in order to have prunes as sweet as possible, is to take them out of the oven when half-cooked, into the open air, where they are left to soften and get rid of their water. After a few hours, the trays are replaced in the oven, where the prunes finish."

On an industrial scale, the process is still much the same, though special ovens or evaporators are now in general use. French prunes are thus always de-hydrated. In the cool climate of Agen, sun-drying would rarely be practicable. In warmer climes, such as California, the sun's heat may be, and very largely *is*, availed of. Oregon, like France, has a cool climate, and dehydration is, of necessity, the rule. Even in climates where sun-drying is possible, it is now being steadily superseded by artificial drying, which results in an increased drying ratio, and a better quality prune.

The commercial processing of prunes comprises the following stages:—

1. Growing and harvesting.
2. Sorting and green grading.
3. Treatment preparatory to drying.
4. Actual drying—(*a*) Traying.
   (*b*) Sun-drying.
   (*c*) Dehydration.
5. Bulking or sweating.
6. Final grading.
7. Final processing.
8. Packing and marketing.

1. Growing and Harvesting.

Prune drying may truly be said to begin in the orchard. On the treatment of the tree depends the quality of its fruit. Pruning, tillage, manuring, and disease control, must receive proper attention; a poorly-grown plum cannot be processed into a good prune. This applies particularly to size, which has been shown to be inseparable from quality. If the crop is too heavy, the fruit must be small. The French 1929 prune crop was a short one, but in compensation the fruit was exceptionally large, and of splendid quality. Some of these "32 to the pound" were recently retailed in Melbourne shops at 4s. 6d. per lb., as against 3s. for French "45's" in jars. There is no doubt that size pays; the best way to ensure it is by restricting the number of fruit on the tree to what it is capable of bringing to perfection, either by hard pruning or by deliberate thinning of the immature fruit. It is the eternal conflict between quality and quantity. Such thinning, within reasonable limits, of course, does not materially reduce the weight of the crop, and any slight reduction there may be is more than made up for by its enhanced value. It also promotes a regular yield each year instead of alternating heavy and light crops. Californians hold that a prune orchard will yield from 3 to 10 tons of fresh fruit per acre; anything over 5 tons is usually at the expense of quality.

Having been properly grown, the fruit must be properly harvested, the most vital requirement being complete maturity. This is absolutely essential. Premature picking not only results in loss of weight, a proportion of the potential sugar not having yet reached the fruit, but it is fatal to quality. A good prune cannot be dried from an imperfectly ripened plum. Insufficient maturity is the most common cause of low-grade prunes.

Harvesting usually commences towards the end of February in the warmer parts of this State; it may continue until the end of March

according to locality and season. Unfortunately, all the plums on a tree do not ripen simultaneously; this process is progressive, over a period of several weeks. Over-ripeness being also undesirable, several pickings must be made. Maturity must not only be complete, but it must be even, otherwise trouble will occur in dipping and drying, the riper fruit processing more rapidly. The dead-ripe fruit that falls from the tree is gathered from the ground, or, better still, from hessian sheets spread under the tree. If shaking be practised, it should be very lightly done, so that none but perfectly ripe fruit is caused to fall.

According to Christie and Barnard*, in California:—

"Prunes are always picked from the ground, which should be smooth and free from vegetation. . . . If they remain on the tree after reaching maturity, it becomes necessary to shake—or even knock the fruit off with poles—before the season becomes too late for sun-drying.

The prune orchard is picked over on the average about four times, at intervals of a week or more. The final picking is preceded by a thorough shaking or knocking—to bring down all the remaining prunes. An average crop requires one picker for 5 to 7 acres. Adult pickers average nearly 1 ton a day, the rate of pay varying from 4 dollars to 6 dollars per ton."

According to Wiegand†, the boxes into which the prunes are picked should not be too large. He considers the large lug-boxes, holding about 60 lb. of fruit, to be unwieldy and unsanitary, besides promoting the development of brown-rot. He recommends the smaller Californian lug-box (nearly two-thirds of an imperial bushel).

After picking, drying must be proceeded with as soon as practicable, as the very ripe fruit rapidly deteriorates. It is a mistake to keep the fruit in cases overnight before processing starts—even this brief storage is detrimental to quality.

2. Sorting and Green Grading.

Sorting should be carried out when harvesting; any fruit that is damaged or faulty, from any cause, being kept apart.

Grading.—The size and condition of the fruit influence the drying rate very considerably. Large fruit dries more slowly than small, and very ripe fruit dries faster than that which is somewhat less mature. In order to secure even drying, and to avoid some prunes being too dry and others not dry enough, grading before drying is very desirable, so that each tray may contain fruit of one size only. Mechanical grading presents some difficulty with so tender a fruit, and one so easily injured, as a very ripe plum. Nevertheless, several machines are in use in Oregon, both of the shaker type, with holes, and of the protected roller type, which gradually widens, dropping the fruit according to size*. In the majority of cases, grading is postponed until later, the one machine executing the three operations of dipping, grading, and traying.

Hand-grading is also recommended; though more costly, it is very satisfactory, since it permits grading according to condition and ripeness, as well as to size and also the elimination of any faulty fruit. In other words, grading and sorting can be executed simultaneously.

* Loc. cit. p. 41.

† Oregon Experiment Station, Bulletin 205—*Drying Prunes in Oregon*, by Ernest H. Wiegand, May, 1924.

(To be continued.)

SUPPLEMENTARY LIST OF FERTILIZERS REGISTERED AT THE OFFICE OF THE DIRECTOR OF AGRICULTURE UNDER THE FERTILIZERS ACT 1928 (No. 3680) FOR THE YEAR 1930.

Description of Fertilizer.	Brand.	Nitrogen.				Phosphoric Acid.				Potash as Sulphate.	Price asked per ton.	Where Obtainable.
		As Ammonia.	As Blood.	As Bone and Blood and/or Flesh.	Total.	As Water Soluble.	As Citrate Soluble.	As Citrate Insoluble.	Total.			
		%	%	%	%	%	%	%	%	%	£ s. d.	
Nitrogenous, moderately soluble.												
Blood Manure ..	Sickle in diamond	..	7·50	..	7·50	..	..	..	..	..	9 5 0	Commonwealth Fertilisers and Chemicals Ltd., 65 William-street, Melbourne
Slowly available.												
Ground Wool Waste	Heiliger's Wool Waste Fertiliser	..	..	..	5·00 (as wool)	..	..	..	..	..	5 10 0	J. Heiliger, Shannon-avenue, Marnock Vale, Geelong
Phosphatic, readily soluble.												
Superphosphate	Lamaco ..	..	..	..	..	20·50	0·50	1·00	22·00	..	4 15 0	New Zealand Loan and Mercantile Agency Co, Ltd., 538 Collins-street, Melbourne
Phosphatic, slowly available.												
Ground Phosphate	Ephos, in scarab	..	..	..	..	..	1·64	25·29	26·93	..	4 15 0	Dalgety and Co. Ltd., 461–471 Bourke-street, Melbourne
Containing Phosphoric Acid and Nitrogen.												
Super. and Ammonia	Cresco (6 in 1) ..	2·85	..	..	2·85	17·48	0·42	0·85	18·75	..	6 17 0	Cresco Fertilisers Ltd., North Geelong
Nitro-Super. ..	Cresco ..	1·50	..	0·50	2·00	16·39	1·10	1·70	19·19	..	7 0 0	„ „ „
Wool Waste and Super.	Bruno A1 ..	..	..	..	3·50 (as wool)	7·90	..	0·78	8·68	..	4 10 0	J. Heiliger, Shannon-avenue, Marnock Vale, Geelong
Mixed Manure ..	Humo-Phos ..	1·28	..	1·03 (as organic)	2·31	..	..	5·46	5·46	..	4 14 0	The Peninsula Lime and Fertiliser Co. Pty. Ltd., 70 Elizabeth-street, Melbourne

SUPPLEMENTARY LIST OF FERTILIZERS REGISTERED AT THE OFFICE OF THE DIRECTOR OF AGRICULTURE UNDER THE FERTILIZERS ACT 1928 (No. 3680) FOR THE YEAR 1930—*continued.*

Description of Fertilizer.	Brand.	Nitrogen.				Phosphoric Acid.				Potash as Sulphate.	Price asked per ton.	Where Obtainable.
		As Ammonia.	As Blood.	As Bone and Blood and/or Flesh.	Total.	As Water Soluble.	As Citrate Soluble.	As Citrate Insoluble.	Total.			
Containing Nitrogen and Phosphoric Acid, moderately available.		%	%	%	%	%	%	%	%	%	£ s. d.	
Blood and Bone	Corio	..	..	5·00	5·00	..	6·50	8·50	15·00	..	9 0 0	The Corio Trading Co. Pty. Ltd., 164 Moorabool-street, Geelong
„ „	Cockatoo ..	..	..	4·56	4·56	..	5·90	5·88	11·78	..	7 0 0	R. Fordham, Cressy-road, Camperdown
„ „	Lighthouse No. 2	..	..	6·00	6·00	..	5·00	2·00	7·00	..	10 0 0 at Portland	Thomas Borthwick and Sons Ltd., 84 William-street, Melbourne
„ „	Brooklyn No. 2 ..	..	..	6·00	6·00	..	8·00	3·00	11·00	..	10 0 0	„ „
Animal Fertiliser	Fitzgerald's ..	..	..	4·08	4·08	..	10·75	7·25	18·00	..	9 10 0	T. Fitzgerald and Sons, Warrigal-road, Oakleigh
„ „	A.N.A. Surprise	..	..	5·00	5·00	..	4·00	10·00	14·00	..	9 10 0	G. W. Pennell, Burke-street, Braybrook
„ „	C.K.	..	..	4·65	4·65	..	6·97	10·25	17·22	..	9 0 0	Joseph Reid, Elliminyt
Bone Fertiliser..	Echuca ..	..	..	4·25	4·25	..	8·25	8·50	16·75	..	9 0 0	W. G. Boyle, Goulburn-road, Echuca
Containing Nitrogen, Phosphoric Acid, and Potash.												
Market Garden Manure	Cresco	1·50	..	1·56	3·06	11·65	1·49	3·26	16·40	2·42	8 10 0	Cresco Fertilisers Ltd., North Geelong
Containing Potash only.												
30 per cent. Potash Manure Salt	Cresco	..	..	..	..	..	..	..	..	30·00 (as chloride)	8 10 0	Cresco Fertilisers Ltd., North Geelong

SUPPLEMENTARY LIST OF FERTILIZERS REGISTERED AT THE OFFICE OF THE DIRECTOR OF AGRICULTURE UNDER THE FERTILIZERS ACT 1928 (No. 3680) FOR THE YEAR 1930—*continued.*

Description of Fertilizer.	Brand.	Nitrogen.	Phosphoric Acid.	Mechanical Condition.		Price asked per ton.	Where Obtainable.
				Fine Bone.	Coarse Bone.		
		%	%	%	%	£ s. d.	
Bonedust	Pioneer ..	3·82	21·96	50	50	8 10 0	W. A. Rainey, Mepunga East, via Allansford

Melbourne, 1st July, 1930.

W. R. JEWELL,
Chemist for Agriculture.

BUTTER MAKING.

(Extracts from a broadcast talk on "Butter Factory Management" by Mr. R. Crowe, Exports Superintendent.)

It is recognized that the making of butter and cheese is more an art than a science, because of the complex composition of milk and cream. The factory manager knows that the fat globules in milk from some breeds of cows are larger than those from other breeds. The colour naturally changes at different times of the year, and efforts have to be made to adjust this. Perhaps his greatest difficulty is to reduce the colour in the spring time, as in some districts it is naturally too high to meet the requirements of the best trade. The butter-fat, too, is complex, and composed of many fats which vary in their relative proportions at different times of the year. These fats have different melting points, so that lower temperatures, especially for churning, are necessary in the spring time as compared with the autumn. On account of variations in pastures, I have found that different churning temperatures have had to be resorted to by two neighbouring factories at the one time of year.

Sometimes milk and cream have been found to behave abnormally in the process of pasteurizing. This has been traceable to the half-dozen different mineral contents becoming unbalanced. Whilst the respective amounts of two of those are fairly constant, the others vary in their relative proportions at different times. The consequent difficulty experienced has been overcome by lengthening the period of heating in the process of pasteurizing.

It is a matter of common knowledge that some foodstuffs taint the milk. I have had milk from cows grazed on clover and trefoil pastures at a certain period of growth which was so nauseous that it had to be used sparingly in either tea or porridge. Turnips, lucerne, Cape weed, and such like, give a taint to the milk.

Some managers assert that since the extended use of superphosphates, milk and cream do not possess such good keeping properties as formerly. This is quite so, as the use of "super." favours the growth of leguminous grasses; the milk from cows on such pasture is more tender or susceptible, and suffers more from infection than milk from cows on natural or rye-grass pastures.

There are fashions in taste the same as in clothes, but of course the fashion in butter does not change so rapidly. Once upon a time, best butter was much more open in texture than that produced at the present day, and it was not considered to be a fault if it showed a clear bead of moisture when cut. Now, it must be of the consistency of wax, and show absolutely no moisture whatever. To produce such a butter requires great care and skill.

A number of years ago, it was the aim of butter-makers to produce an article that had a full nutty flavour characteristic of good butter. Now, it is a mild-flavoured butter which is most in demand.

PROSECUTIONS UNDER THE "FERTILIZERS ACT 1928."

FOR SELLING AN UNREGISTERED FERTILIZER.

On the 1st July, before Mr. D. Berriman, P.M., Gibbs, Bright, & Co. were charged under the *Fertilizers Act* 1928, with having sold a fertilizer, "Dissolved Guano," which was not registered with the Department of Agriculture. Mr. Wilson, of the Crown Law Department, appeared for the prosecution, and Mr. S. Lewis for the defendant company.

Mr. W. C. Robertson, of the Chemical Branch of the Agricultural Department, gave evidence regarding particulars of the sale, and stated that the fertilizer in question had previously been refused registration. Counsel for the defendant company, in answer to a question from the Bench, admitted that registration had been refused on the grounds that the price charged was considered excessive. The defendants pleaded guilty, and were fined £10, with £5 5s. costs.

The Fertilizers Act is designed primarily for the protection of the farming community, and the Government is determined that its provisions shall be enforced to the full. Before buying any fertilizer with which they are not familiar purchasers, in their own interests, should take steps to ascertain whether it is registered with the Department of Agriculture. Purchasers can help in administering the Act, and thus further protect themselves, by reporting immediately to the Chemist for Agriculture, Melbourne, any unregistered fertilizer that is offered to them.

FERTILIZER BELOW GUARANTEE.

Cresco Fertilizers Ltd., of North Geelong and Adelaide, were prosecuted on 15th July under section 16 of the Fertilizers Act for selling a fertilizer, Cresco 24 per cent. Superphosphate, that was below the guaranteed analysis. The case was heard in the Geelong Court of Petty Sessions before Mr. D. W. O'Grady, P.M., and a bench of honorary justices.

The official analyst, Mr. W. C. Robertson, of the Department of Agriculture, stated in evidence that he took a sample of the fertilizer in question, and on analysis found it to be 1.04 per cent. below the guaranteed amount of phosphoric acid. This deficiency was in excess of the limit allowed by the Act. The facts were not disputed, and the defendant firm pleaded guilty, and were fined £5 with £6 3s. 10d. costs.

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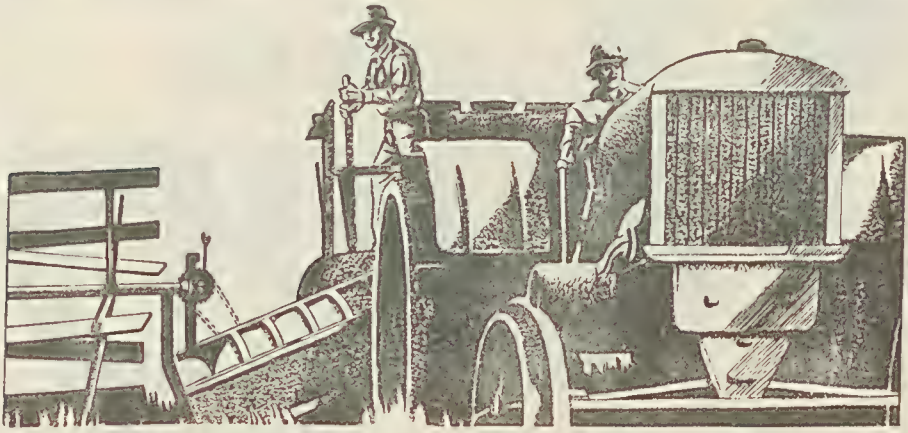

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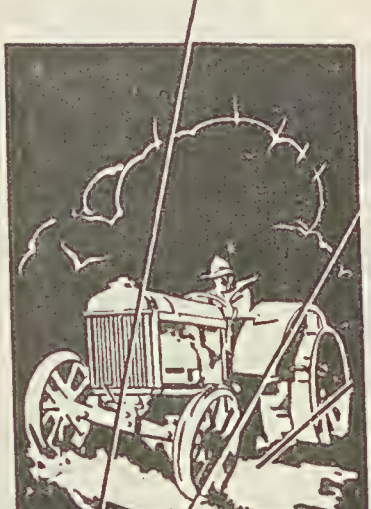

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1,000	3 9	4 0	4 6	5 0	5 6	6 0	7 0	7 6	8 6	10 0
2,000	7 3	8 0	9 0	10 0	11 0	12 0	14 0	15 0	17 0	1 0 0
3,000	10 9	12 0	13 0	15 0	16 0	18 0	1 0 0	1 2 6	1 5 6	1 10 0
4,000	14 6	16 0	17 6	19 6	1 2 0	1 4 0	1 7 0	1 10 0	1 14 0	1 19 0
5,000	18 0	1 0 0	1 2 0	1 5 0	1 7 6	1 10 0	1 14 0	1 17 6	2 2 6	2 8 0
10,000	1 16 0	2 0 0	2 4 0	2 9 0	2 14 6	3 0 0	3 8 0	3 15 0	4 5 0	4 16 0

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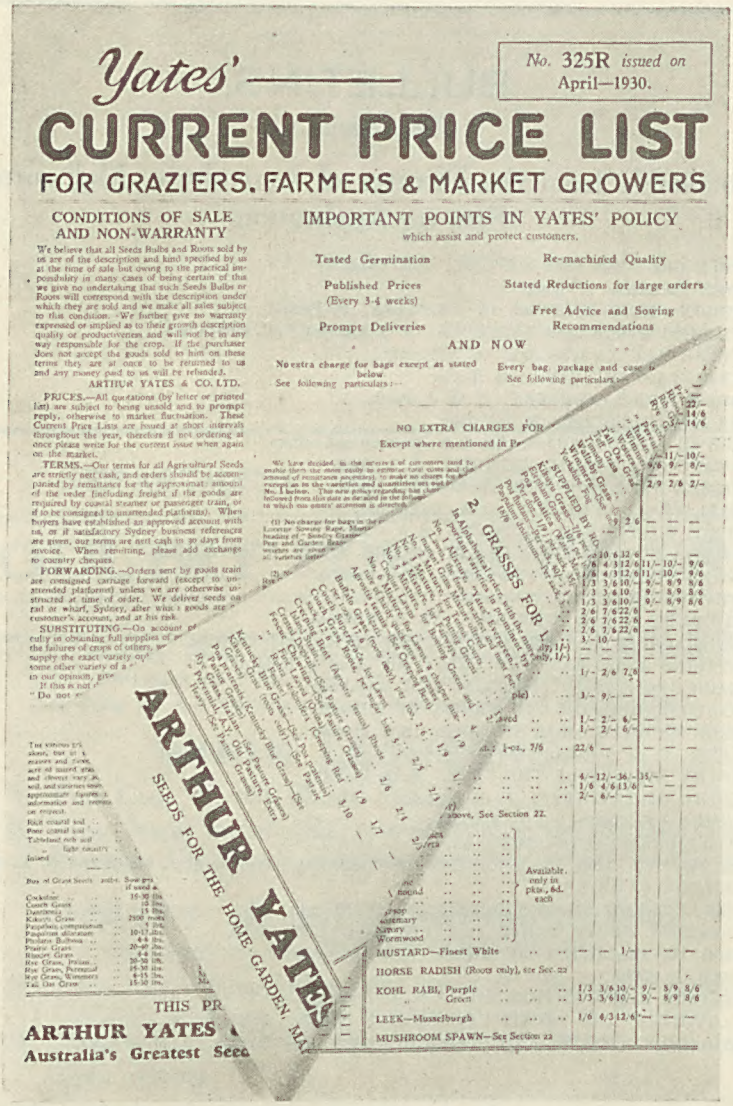
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